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Energy Research Abstracts

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UNITED STATES DEPARTMENT OF ENERGY

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ENERGY RESEARCH ABSTRACTS

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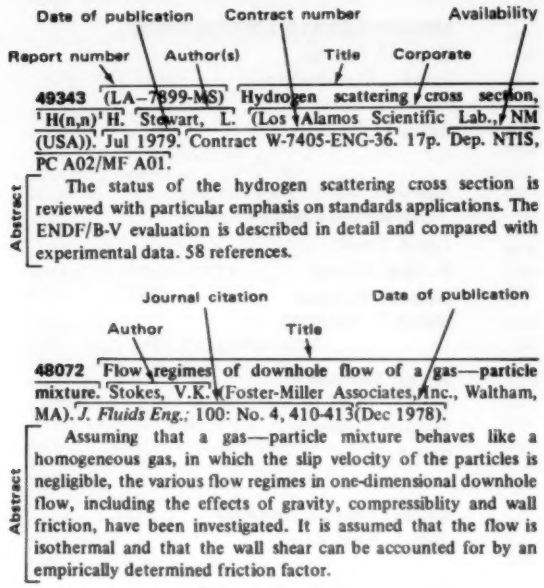
Date of publication
Contract number
Availability
Report number
Author(s)
Title
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49343 (LA–7899-MS) Hydrogen scattering cross section, ¹H(n,n)¹H. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.
Abstract
The status of the hydrogen scattering cross section is reviewed with particular emphasis on standards applications. The ENDF/B-V evaluation is described in detail and compared with experimental data. 58 references.
Journal citation
Date of publication
Author
Title
48072 Flow regimes of downhole flow of a gas—particle mixture. Stokes, V.K. (Foster-Miller Associates, Inc., Waltham, MA). J. Fluids Eng.; 100: No. 4, 410-413 (Dec 1978).
Abstract
Assuming that a gas—particle mixture behaves like a homogeneous gas, in which the slip velocity of the particles is negligible, the various flow regimes in one-dimensional downhole flow, including the effects of gravity, compressiblity and wall friction, have been investigated. It is assumed that the flow is isothermal and that the wall shear can be accounted for by an empirically determined friction factor.

•INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. These indexes are cumulated semiannually and annually. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

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Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

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is indexed as:

Los Alamos Scientific Lab., NM (USA)
Advanced laser fusion target fabrication research and development proposal, 4:48249 (LA–7619-P)
Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA–7899-MS)

•Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Stewart, L., Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA–7899-MS)
Stewart, M.D., *See* McInroy, J.F., 4:49280
Stewart, W., *See* Dean, J.W., 4:48543
Stimson, J., Reproduction, growth, and survival of Enewetak corals, 4:49200 (NVO–0703-1, pp 56-59)

•Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

HYDROGEN 1 TARGET/NEUTRON REACTIONS
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HYDROGEN NITRATES
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HYDROLOGY/RESEARCH PROGRAMS
Inventory of advanced energy technologies and energy conservation research and development: 1976-1978. Volume II. Prepared for the Committee on Science and Technology, U.S. House of Representatives, Ninety-Sixth Congress, 4:48749

•Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

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	3:49857	LA–7224T
	3:49863	LA–7235-MS
W-7405-ENG-48	**California Univ., Livermore (USA). Lawrence Livermore Lab.**	
	3:49386	UCRL–52456
	3:49431	UCRL–52405

•Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

LA-		
7899-MS	**4:49343**	**Dep. NTIS, PC A02/MF A01**
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Volume 5, Number 11, June 15, 1980

ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

PROCESSING

REFER ALSO TO CITATION(S) 18837

CARBONIZATION

18299 Metallurgical coke, chemicals, and fuels by the CLEAN COKE process. Boodman, N.S. (US Steel Research Lab., Monroeville, PA); Miller, C.T. pp 359-388 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

The CLEAN COKE process was designed to convert low-grade coals into metallurgical coke, chemical feedstocks, and liquid and gaseous fuels. The process combines fluid-bed carbonization and coal hydrogenation to produce devolatilized, low-sulfur char and binder oil that are further processed to make high-strength formcoke pellets. Liquids and gases formed during carbonization and hydrogenation are processed to produce chemicals and fuels. An investigative program was carried through the process-development stage. The carbonization and hydrogenation process-development units were each sized to accommodate 500 lb per day of coal feedstock. Coals from the Illinois No. 6, Kentucky No. 9, and Pittsburgh No. 8 Seams were processed in the carbonization unit without agglomeration to produce char. Quality binder oils were prepared from SRC-I product by a fluxing-airblowing-thermal treatment sequence. An economic analysis was prepared for a commercial facility designed to process 12.43 million tons per year Illinois coal to produce 3.6 million tons from formcoke, 1.5 million tons of chemical products, and more than 33 trillion Btu of liquid fuel. Several alternative design bases were also evaluated.

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 18320, 18332, 18340, 18369

18300 (FE—1806-78) **High-temperature turbine technology program low-Btu gas, low-temperature chemical cleanup pilot plant. Design, construction, startup, and operation.** Horner, M.W. (General Electric Co., Schenectady, NY (USA). Gas Turbine Div.). Feb 1980. Contract EX-76-C-01-1806. 89p. Dep. NTIS, PC A05/MF A01.

The completion of the low Btu gas, low temperature cleanup system pilot plant represents a major step toward a complete integrated coal gasification pilot plant which simulates the full-scale commercial Coal Gasification Combined Cycle Plant. Several important programmatic and technical milestones in the HTTT Program were attained during the design, construction, and startup of the pilot-scale chemical cleanup system: Process and detail system design, procurement, and construction were completed within two weeks of the original mechanical completion date estimated over 1-1/2 years previously. The full cleanup facility was brought on-line for fired tests within one week of the date targeted. The ability to operate the system in a 30-hr fired test after only three short attempts at fired operation, attests to the excellence of the plant design, preparation, and operation personnel. The full cleanup system operated with only two GE supervisors and two temporary hired laborers per shift during this initial phase of operation. The performance of the Benfield system met or exceeded expectations based on sulfur and carbon dioxide removal. The reheat and saturation equipment performed well and controllably. No evidence of foaming or mist carry-over to the process gas stream was observed, and the particulate and alkali loading of the clean process gas was well within design limitations. The ability of the separators to decant heavy tars has not yet been demonstrated. From this initial period of testing, it appears that the system met or exceeded the design goals in all critical areas. Obviously, additional and more extended testing will be required to fully evaluate the long-term operation and performance of the system. Modifications to the facility made to minimize or eliminate the operational problems observed during the startup and evaluation tests are described.

GASIFICATION

REFER ALSO TO CITATION(S) 18300, 18341, 18345, 18346, 18347, 18351, 18354, 18355, 18356, 18368, 18506

18301 (FE—2340-8) **Improved techniques for gasifying coal. Eighth quarterly report, April 1-June 30, 1978.** Graff, R.; Yerushalmi, J.; LaCava, A.I. (City Univ. of New York, NY (USA)). Aug 1978. Contract EX-76-S-01-2340. 61p. Dep. NTIS, PC A04/MF A01.

In the work runs made with Ireland Mine coal in 50 atm of hydrogen are consistent with the results previously observed at 75 and 100 atm: with decreasing pressure total yields increase, light product yields decrease. Work was begun on the design of reactors for flash hydrogenation at the commercial scale. It is the objective to place alternative systems before the technical community along with our recommendations. It is immediately apparent that dilute phase transport reactors, which are presently being put forward for commercialization, suffer from three disadvantages: they are operable only at high temperatures, beyond the range for optimum production of light liquids; hydrogen required for solids transport is about 10 times the stoichiometric equipment (this makes heat management difficult and product separation expensive); and excessively high hydrogen feed temperatures are required, which are beyond the capability of indirectly fired heaters and can be met only by direct combustion with oxygen. We have concentrated on the ability of high velocity beds to reflux the exothermic heat of reaction, thereby reducing the hydrogen preheat requirements. Heat balance calculations show that these requirements are well within the range of indirectly fired heaters. Precombustion with oxygen is not required and the estimated savings in reducing the size of both the gasifier and oxygen producer is about 10% of the total plant capital cost. The implementation of a high temperature cracking zone was completed, and preliminary runs were carried out. Little change in the yields of light products are observed in the cracking zone up to 900°C with a residence time of one second.

18302 (FE—2542-22) **PHASE I: the pipeline gas demonstration plant. Site Master Plan.** DiFulgentiz, R.A. (ed.). (Conoco, Inc., Stamford, CT (USA)). Sep 1979. Contract EF-77-C-01-2542. 20p. Dep. NTIS, PC A02/MF A01.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the US Department of Energy (DOE) requires Conoco Inc. to design, construct, and operate a Demonstration Plant capable of converting high-sulfur bituminous caking coal to high-Btu pipeline quality gas. One of the assignments under the contract is to prepare a site master plan which is presented herein. The Site Master Plan confirms the suitability of the selected Noble County, Ohio, plant site for construction of the Demonstration Plant. It identifies the approximately 325 acres to be set aside for the plant within the overall property parcel of 1,245 acres. Tentative orientation of the major plant facilities are shown and future growth areas are indicated.

18303 (FE—3125-8) **Advanced development of a short-residence-time hydrogasifier. Third quarterly technical progress report, April 1, 1979-June 30, 1979.** (Rockwell International Corp., Canoga Park, CA (USA)). Aug 1979. Contract ET-78-C-01-3125. 181p. Dep. NTIS, PC A09/MF A01.

Testing started with a one-quarter ton/hr hydrogasifier. A 3/4 TPH unit is now ready for testing and a 4 TPH unit is being designed. Reasons are given for various modifications of these units and their components. (LTN)

18304 (FE—6010-20) **Materials research for the clean utilization of coal. Quarterly progress report, April-June 1979.** Schneider, S.J. (National Bureau of Standards, Washington, DC (USA). Center for Materials Science). 1979. Contract EA-77-A-01-6010. 50p. Dep. NTIS, PC A03/MF A01.

Work at the US Bureau of Standards on materials for coal gasification plants is described. Slags (viscosity, electric conductivity (including temperature dependence in both cases), vaporization of alkali compounds, etc.), refractories (creep, chemical reactions and transformations, deformation, erosion, etc.), a failure information center and failure analysis, mechanical properties of construction materials, and creep and corrosion in MHD generators. (LTN)

18305 Kinetic models for pyrolysis and hydrogasification of Hanna coal. Rai, C.; Tran, D.Q. (Univ of Wy, Laramie). *Fuel;* **58**: No. 8, 603-608(Aug 1979).

A kinetic study of non-catalyzed and catalyzed coal was conducted using a DuPont 951 thermogravimetric analyzer. A kinetic model in which the apparent activation energy is assumed to be a rectilinear function of the extent of reaction was used to describe the pyrolysis of Hanna coal. For the hydrogasification of char the apparent activation energy was found to vary as a second degree polynomial with respect to conversion.

18306 (JUEL—1617) **Documentation of the energy and mass balance for ADAM I (on-line operation).** Harms, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente). Sep 1979. 126p. (In German). Dep. NTIS (US Sales Only), PC A07/MF A01.

The methanation process is of considerable importance to both the production of Substitute Natural Gas on the basis of coal gasification and the Nuclear Long-Distance Energy System. The report describes how the data resulting from experiments with pilot plant ADAM I were recorded and integrated into a computer program. The experimental results are of use to the optimization of the methanation process within the Nuclear Long-Distance Energy System.

18307 Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979). 792p. (CONF-790598—). $60.00.

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

The symposium on Advances in Coal Utilization Technology was sponsored by the Institute of Gas Technology and held at Louisville, KY, May 14-18, 1979. The papers deal mainly with coal gasification, coal liquefaction, and electric power generation (including forecasts to 2000). Thirty four papers have been entered individually into the data base; three had been entered previously. (LTN)

18308 Coal gasification power plant and process. Woodmansee, D.E. (to General Electric Co.). US Patent 4,150,953. 24 Apr 1979. Filed date 22 May 1978. 10p.

In an integrated coal gasification power plant, a humidifier is provided for transferring as vapor, from the aqueous blowdown liquid into relatively dry air, both (I) at least a portion of the water contained in the aqueous liquid and (II) at least a portion of the volatile hydrocarbons therein. The resulting humidified air is advantageously employed as at least a portion of the hot air and water vapor included in the blast gas supplied via a boost compressor to the gasifier.

18309 Coal gasification technology overview. Bodle, W.W.; Schora, F.C. (Inst. of Gas Tech., Chicago, IL). pp 11-34 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

Coal gasification processes are reviewed and compared, with brief descriptions of the various processes. (LTN)

18310 Department of Energy Coal Gasification Program: an overaview. Miller, C.L. (Dept. of Energy, Washington, DC). pp 63-74 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

These general trends in the evolution of gasifier concepts and gasification processes reflect what has been occurring in the Government's Coal Gasification Program as it has changed from the Office of Coal Research to become a part of the Department of Energy after passing through the Energy Research and Development Administration on the way. The program itself, its growth, trends, current emphasis and its direction can perhaps best be reviewed by associating the dollars of the requested budget authority with the major divisions of the program. The requested budget authority for the fiscal years of 1979 nd 1980 for the Surface Coal Gasification Program are shown in a table.

18311 Great Plains Gasification Associates Coal Gasification Project. Mujadin, M.J. pp 35-61 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

The Great Plains Gasification Associates Coal Gasification Project is a commercial sized demonstration plant designed to produce 125 MMCFD of pipeline quality gas from North Dakota lignite utilizing Lurgi technology. The project is sponsored by five of the largest gas pipeline companies in the country and has the support of the state government of North Dakota and the US Department of Energy. After six years of technical, environmental and economic sudies, this project has acquired nearly all the required permits to begin construction. Under the name ANG Coal Gasification Project, over $30,000,000 has been spent to reach this point. Only an acceptable FERC Certificate which would permit project financing to proceed is still required to set in motion the final phases of the project: detail design and procurement; construction and start-up. The FERC Administrative Law Judge is currently deliberating on the evidence for and against this project. His ruling and the ultimate Commission certificate, if positive and timely, should result in the first large volumes of SNG from coal being produced in late 1983. This paper presents an overview of the Great Plains Project past and present and describes those features which make this project unique.

18312 High Btu Coal Gasification Demonstration Program. Lloyd, E.A. (Dept. of Energy, Washington, DC). pp 75-81 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

The High Btu Pipeline Gas Demonstration Program is one of the major elements of DOE's efforts to create a strategic technological position with respect to the nation's gas supply. The Process and Program Management organization is designed to provide the more formal management of large programs like the High Btu Coal Gasification Demonstration Program which includes two competitive projects; one proposed by the CONOCO Coal Gasification Group. These projects are candidates for selection as the project and process that is to proceed to final design for construction of the single High Btu Pipeline Gas Demonstration plant for which funds have been appropriated by the Congress. The present demonstration plant program is to complete construction of one demonstration plant in 1983, incorporating the best technology available so that the commercial, private, interests can build profitable gasification plants with confidence. The High Btu Coal Gasification Demonstration projects have three phases. Phase I is a design phase, already underway; Phase II will be a construction phase; and Phase III will be an operation phase. Phase I is funded by DOE; Phases II and III will be funded equally by DOE and the industrial partner selected. The CONOCO process uses an adaptation of the Lurgi gasifier with a British gas developed bottom to produce a slag rather than dry ash. The ICGG process combines the COED-staged pyrolysis process with the COGAS gasification process.

18313 Small gasifiers in indu try. McGurl, G.V. (Dept. of Energy, Washington, DC). pp 111-131 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

Three basic types of gasifiers fall conveniently into the category of small industrial gasifiers: single-stage fixed bed, two-stage fixed bed, and fluidized bed. We should note that this DOE program was restricted to processes which had been commercially demonstrated somewhere in the world, but not necessarily in the US. Several of these small gasifiers are described, including operating problems which developed in start-up of the University of Minnesota, Duluth campus gasifier.

18314 Coal gasification program in the Federal Republic of Germany. Holighaus, R. (Kernforschungsanlage, Juelich, Germany). pp 133-166 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

The non-nuclear energy R and D program of the Federal Republic of German was started in 1974. Within this program the main emphasis was given to coal conversion processes. Due to the fact that a proven German technology already existed in the past, our efforts were directed mainly towards improving these processes by applying new components, materials and control methods meanwhile developed in other technical fields. This is especially true for coal gasificaion. Based on the different types of gasifiers such as Lurgi, Koppers-Totzek, Winkler, Rummel-Otto, improvements were aimed at with respect to thermal efficiency, unit capacity, reliability, investment costs, and environmental acceptability. Meanwhile the

respective pilot plants with capacities of up to 15 t/h were either just in the start-up phase or were already being operated successfully. The paper gives technical descriptions of the proceses, deals with the objectives and the schedule of the different projects and reports the results and experiences so far gained. Besides the improvement of existing technology, new process devlopments were started which shall enable the incorporation of nuclear process heat. Based on conceptual consideration, two different processes were designed and tested on a semi-technical scale. The results obtained were used for the design of a pilot plant, which will start operation within three years. The overall concept of the process using nuclear process heat will be presented and discussed, the results so far obtained from the test plants will be included.

18315 Advances in coal conversion technology: catalytic gasification. Woodcock, K.E. (Dept. of Energy, Washington, DC). pp 179-204 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

Conclusions drawm from recent work on the effects of catalysts (mostly alkali metal carbonates) on coal gasification are: (1) laboratory and bench scale experiments have expanded the data base related to catalytic coal gasification and continue to indicate that the use of catalysts may offer an effective way to alter coal gasification reactions; (2) investigations of the catalysts and coal gasification reactions at the laboratory scale continue to improve our understanding of the interaction of the many factors involved; (3) process economic studies using experimental data being generated at the bench scale continue to indicate that catalytic coal gasification may offer significant economic advantages over alternative processes now available or under consideration; (4) the continued indication of technical feasibility and economic incentives provides a basis for additional evaluations of process concepts, investigations of process fundamentals, assessments of the environmental implications of catalytic coal gasification, and a more serious consideration of the interactions which may occur with materials of construction.

18316 Evaluation of coal conversion catalysts. Lee, A.L. (Inst. of Gas Tech., Chicago, IL). pp 205-218 of Advances in coal utilization technology. Chicago, IL, Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

Methods of evaluation of both conventional methanation and sulfur-resistant shift/methanation catalysts are described. Forty-one conventional methanation catalysts and nine sulfur-resistant shift/methanation catalysts were evaluated. Generalized rate equations were developed and limitations were specified. The following general conclusions are based on the findings of the catalyst evaluation program during the past seven years: four of the nine catalysts tested show potential for shift reaction prior to water quenching in coal gasification processes; these four catalysts identified by manufacturer's code, are sulfur-active catalysts and can be activated by the sulfur-containing feedstock. The activity may be even higher if a presulfiding procedure is used; phenol reduces the activity of all the catlysts; carbon deposition is detectable at high temperatures, low steam-gas ratios, and high benzene concentrations; pressure affects the activity of catalysts more than temperature, especially at higher space velocities; in our study of shift catalyst behavior, we found that a large number of reactions must be considered in the detailed analysis of experimental data.

18317 Underground coal gasification technologies. Burwell, E.L. (Dept. of Energy, Washington, DC). pp 219-236 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

The recently enacted National Energy Act calls for accelerated development in the use of our abundant domestic coal reserves as a viable alternative to imported oil. Any technology developed will have to meet increasingly severe economic, socioeconomic, logistical, and environmental criteria in order to become a commercial reality. Underground coal gasification (UCG) promises to become one of the viable alternatives. This paper presents the current US program which is addressing the production of energy by UCG from coals of widely varying geologic characteristics. The production of low and/or medium Btu gas from flat, thick subbituminous seams; the gasification of steeply dipping coal seams; and preliminary field tests in deep bituminous coal seams are all under current investigation. These technologies, if developed, could quadruple the amount of coal recoverable in the US by addressing coals economically inaccessible by current surface and deep mining techniques. Based on the field tests already completed, underground coal gasification technologies should reach the point of commercial decision by the late 1980's.

18318 Coal gasification: University contribution to the story of devolatilization, catalysis, and active sites. Walker, P.L. Jr. (Pennsylvania State Univ., University Park). pp 237-271 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

Advances in the broad unit operation of coal gasification will continue to depend to an important extent upon the input of university researchers. The over-all process of coal gasification can be broken down into its major component parts, that is coal pretreatment, coal devolatilization, reaction with nascent carbon sites, and reactivity of coal chars. Progress which some university researchers have and are making towards our understanding of these areas is considered in this paper.

18319 Transportation fuels from synthesis gas. Fischer, R.H.; Hildebrand, R.E. (Dept. of Energy, Washington, DC). pp 331-343 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

The focus of DOE's program in synthesis gas conversions is anticipated to be in the following areas: conversion of low ratio of H_2/CO synthesis gas to liquids; use of shape selective catalysts to inhibit or circumvent the Schulz-Flory polymerization mechanism; further development of the M-Gasoline Process; use of single pass, high thermal efficiency reactor systems; and alternative upgrading methods for Fischer-Tropsch liquids. It is believed that success in these areas as well as in the gasification of coal to make clean synthesis gas could make the indirect coal liquefaction a very competitive method for converting coal to quality transportation fuels.

18320 University research in coal conversion. Schrodt, J.T. (Univ. of Kentucky, Lexington). pp 389-406 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

University researchers are making significant contributions to the development of coal conversion technology. Much of the financial support for this work is issued through the Universities Activities Program instituted by the United States Department of Energy. The primary purpose of this paper is to highlight some of the research accomplishments of a selected few university research projects in the areas of liquefaction and gasification. Some introductory comments are made on behalf of the University Program.

18321 Current status of the Texaco coal gasification process. Child, E.T. (Texaco Development Corp., New York, NY). pp 763-777 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

The Texaco coal gasification process (TCGP) and the closely related Texaco synthesis gas generation process (TSGGP) are extremely flexible processes that have been evolving over the years to meet the needs of a variety of industries using hydrogen- and carbon monoxide-containing synthesis gas as raw material for numerous end uses. The TSGGP, designed for fluids which are pumpable at temperatures as high as 600°F, was originally developed to produce synthesis gas from natural gas and modified to handle light liquid hydrocarbons such as naptha, followed by oil and, in recent years, very heavy vacuum residues including asphalts. Even with today's accelerating interest in coal as a basic energy and raw material source, there is a strong emphasis on the use of residual and other heavy oils as feedstock for the TSGGP. The TCGP, designed for solid carbonaceous feedstocks, evolved from the TSGGP during two periods of several years each when there was a strong interest in using coal feedstocks. The current energy crisis has resulted in a concerted effort, starting in 1973, to develop the TCGP into a highly flexible process taking full advantage of the earlier developments and the modern technology incorported into the closely related TSGGP. Thus emphasis has been on the development of the technology required to permit the design, construction, and operation of commercial TCGP plants with a minimum of pilot-plant demonstration work.

18322 (LIB-tr—4843) Boron containing nickel catalysts for the conversion of carbon monoxide into methane. Hammer, H.; Hakim, I. Translated from *Chem.-Ing.-Tech.*; 50: No. 8, 622-623(1978). 6p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The present investigation involved the evaluation of variously prepared boron-containing nickel catalysts activated with diverse catalyst promoters for the methanization of carbon monoxide in a continuous flow tube reactor at normal pressure, temperatures up to 450°C and at space velocities of above 10,000 h^{-1} the gas employed being generated (Frischgas) gas (H_2:CO = 3:1). The better catalysts from these experimental series produced good C- conversion ratios of almost 100% and exhibit virtually no drop in activity after 1400

operating hours. The advantage of the boron containing nickel catalysts over the known methanizing catalysts appears, in the light of observations made so far, to be their greater resistance against poisoning by sulfur compounds. Although this problem is not encountered in the use for CO removal from NH_3- synthesis gas, it will have to be borne in mind in connection with any future coal based SNG production process. The role of boron as probable energetic and structural promoter or co-catalyst requires still to be clarified.

18323 (RISLEY-Trans—4106) **Market prospects and economics of nuclear gasification of coal to synthetic natural gas.** Breyer, W.; Wiegand, D.; Bode, K.H.; Oesterwind, D.; Schrader, L. Translated from *Reaktortag.;* 1011-1014(1977). 6p. Dep. NTIS (US Sales Only), PC A02/MF A01.

This investigation was restricted to the heat market of the Federal Republic of Germany. In addition to coal gasification, the use of HTRs for producing nuclear district heat was also investigated. The estimated potential use of SNG and nuclear district heating is together 30 million tons coal equivalent in the year 2000 and 120 million tons in 2025. Twelve nuclear process heat plants of 3000 MW(t) each are required in 2000 and 52 in 2025. (DLC)

18324 (LIB-tr—4847) **Use of mathematical models for the study of packed bed gasification.** Klose, E.; Toufar, W. Translated from *Energietechnik;* **26**: No. 12, 546-555(1976). 22p. Dep. NTIS (US Sales Only), PC A02/MF A01.

An attempt has been made in the two models presented to express the happenings during pressurized packed bed gasification to cover (detect) the problems of heat transfer and of chemical reactions including mass transfer in one algorithm each. To this end it is necessary to make many simplifications and assumptions because the current knowledge on the precise pattern of the processes and material (physical) data of the gasification materials are extremely inadequate. The calculation of complete temperature and concentration profiles has however provided the foundation for further development which promises every success. For this to occur, it will be necessary to accumulate further findings on the complex interrelationships between reaction kinetics and mass transfer and also between flow patterns and heat transfer. The models permit the obtaining of information on the significance of all important parameters on the process pattern and the various relationships established through them may be regarded as providing a true picture of the industrial process. The results from the mathematical model of packed bed gasification permit the making of final conclusions on such important technical problems as: the precise determination of the maximum reaction temperature; the effect of particle size of the gasification charge material on temperature and concentration distribution patterns; the bed depths needed in gasification reactors; the effect of various parameters on the technical and economical operating result; and that the measures which can be derived from this information may make a contribution toward making the process more intensive.

LIQUEFACTION

REFER ALSO TO CITATION(S) 18299, 18307, 18320, 18354, 18368

18325 (DOE/ET/14803—T1) **Coal liquefaction catalyst development. Quarterly progress report No. 1.** Kim, D.K.; Pellet, R.J.; Robinson, K.K.; Mahoney, J.A. (Amoco Research Center, Naperville, IL (USA)). Aug 1979. Contract AC01-79ET14803. 56p. Dep. NTIS, PC A04/MF A01.

Work in Catalyst Preparation and Screening was concerned with modification of product workup procedure and elimination or reduction of uncertainties in the analysis of data from batch autoclave screening runs. Toluene was substituted for benzene as a solvent in the product workup because of the health hazard associated with the use of benzene and was added to the product prior to filtration in order to expose both liquid and solid product to the solvent. The conversion was about the same, using either the old benzene or new toluene product workup. The Engelhard dry coal charging device was used in an attempt to eliminate uncertainties in the batch screening data analysis. After considerable experimentation, use of the charging device was abandoned because of problems with plugging, temperature upsets, and catalyst coking. The effort in Catalyst Aging Tests with Eastern and Western Coal was centered around preparation of enough liquefaction solvent for the DOE program. In the application of new catalysts to the H-Coal process work centered around the 500 pound batch Amocat-1A (CoMo) received from W.R. Grace Company Catalyst inspection data were acceptable and, according to a recent HRI report, the performance results of the 500 pound batch were equivalent to or better than those of an earlier experiment Amocat-1A that HRI tested. The batch of catalyst was also tested in our continuous flow pilot plant, but results were inconclusive since lined-out slurry oil contained unconverted coal particles.

18326 (EPRI-AF—884) **Preliminary engineering evaluation of promising coal liquefaction concepts. Final report.** Agarwal, D.; Cicalese, J.J.; Harkins, J.H.; McShane, M.T.; Oriolo, D.J.; Polek, J.R. (Catalytic, Inc., Philadelphia, PA (USA)). Dec 1979. 201p. Dep. NTIS, PC A10/MF A01.

Several potentially attractive coal liquefaction concepts were evaluated to guide EPRI in planning future research projects. Each concept was developed into a fully-integrated design, self-sufficient in fuel and power, processing 10,000 tons of coal per day in the liquefaction section. Emphasis was placed on producing clean-burning solid and liquid fuels suitable for electric power generation. Six processes were investigated: flash hydrogenation, supercritical gas extraction, conventional solvent refined coal (with filtration of ash), two-stage solvent refined coal, conventional solvent refined coal (with critical solvent deashing), and short contact time solvent refined coal (with critical solvent deashing and hydrotreating). For the liquefaction sections, detailed material balances, process flow diagrams, equipment specifications, utility requirements and estimated costs were developed. For areas ancillary to the liquefaction sections, terminal material balances, overall utility requirements and estimated costs were calculated. Uniform assumptions and procedures were maintained to permit area-by-area comparisons of the processes evaluated. Production of gaseous fuels or chemical feedstocks was not considered, although studies indicate that some of the subject processes may have been penalized by constraining them to a limited product slate. This study shows that the conventional SRC design produced the highest thermal efficiency and product heating value, primarily due to the higher recovery of SRC when using filtration as compared to Critical Solvent Deashing for ash removal. Therefore, further development of the SRC process with filtration is recommended.

18327 (EPRI-AF—1295) **Conversion of oil-fired boilers to coal-derived liquid fuels. Final report.** Cleggett, J.T.; Forbes, H.B. (Stone and Webster Engineering Corp., Boston, MA (USA)). Dec 1979. 86p. Dep. NTIS, PC A05/MF A01.

This report deals with the Conversion of Oil-Fired Boilers to Coal-Derived Liquid Fuels. Detailed characteristics of five types of Exxon Donor Solvent Coal-Derived Liquid Fuels (EDS fuels) were furnished by Exxon Research and Engineering Company for comparison with a typical No. 6 fuel oil. Three existing oil-fired power plants were surveyed to identify problems, if any, associated with handling, storage, pumping, and burning of EDS fuels. Handling system, storage, pump, boiler and associated equipment manufacturers were contacted and requested to comment on the effects the various types of EDS fuels would have on the equipment. Based on this information, the modifications to handling, storage, and burning equipment were qualified for each type of EDS fuel. An engineering order-of-magnitude estimate was prepared for each plant. It was concluded that only the Type 3 EDS fuel, which is a very heavy product containing the 700°F plus products, would require significant modifications to existing equipment and operating procedures at oil-fired power plants. The four remaining types of EDS fuels could be used as boiler fuels if modifications and/or parallel equipment were installed. Additional treatment of the EDS fuel during the liquefaction process, or the development of an additive that would make EDS fuels compatible with petroleum fuels, might eliminate the need for modifications and/or parallel equipment. The cost of modifications varies for each plant and fuel combination, and ranged from approximately $250,000 to $3,400,000. Finally, actual combustion tests of EDS fuels should be performed when sufficient quantities are available to confirm the results of this report.

18328 (EPRI-AF—1297) **Engineering evaluation of conceptual coal conversion plant using the H-coal liquefaction process. Final report.** Buckingham, P.A.; Ravikumar, R.; Leavitt, A.A. (Fluor Engineers and Constructors, Inc., Irvine, CA (USA)). Dec 1979. 199p. Dep. NTIS, PC A09/MF A01.

The objective of the work reported herein was to develop the capital costs and the product costs for an H-Coal liquefaction facility, using the most recent yield data from HRI's PDU unit for Illinois and Wyodak coals. A key part of this effort was the development of a processing configuration for each of the two cases in order to provide self-sufficient facilities with respect to hydrogen, fuel, electric power, and all other utility services. In each case, the overall facility consists of a coal liquefaction plant along with the required support, utility and offsite facilities to comprise a self-sufficient operation. The major processing sections included coal preparation, coal liquefaction and product separation, light ends processing, hydrogen plant, oxygen plant, emission control systems, effluent control systems, product storage and shipping, utility systems and offsites. Capital costs upon a mid-1979 basis are $1.146 billion and $1.315 billion, respectively. Total capital requirements, operating costs and product prices have been determined using EPRI's economic premises, all described in the report. The primary products naphtha, turbine oil, and distillate fuel oil are desulfurized to very low levels. However, the oxygen content of all three products is very high, ranging well over 1% in the Wyodak case, while the

nitrogen content of the turbine oil and the distillate fuel oil exceeds usual levels for conventional petroleum stocks. Accordingly, additional product upgrading may be required to produce commercially acceptable products. Other work aimed towards identifying limits on nitrogen and oxygen and developing the necessary upgrading technology is being actively pursued by both EPRI and DOE. Product costs cited above are generally representative of costs predicted for coal liquefaction processes. The information should prove useful in comparing various coal liquefaction technologies.

18329 (FE—1224-80) **Project lignite. Final technical report, March 28, 1972-June 15, 1977.** Severson, D.E. (North Dakota Univ., Grand Forks (USA). Engineering Experiment Station). 1977. Contract EX-76-C-01-1224. 100p. Dep. NTIS, PC A05/MF A01.

This final report describes work performed and results achieved under Project Lignite for the contract period from March 28, 1972, to June 15, 1977. It describes the development of the concept of the two-stage liquefaction of lignite, the first stage being the production of solvent refined lignite (SRL) by noncatalytic solvent hydrogenation, and the second the upgrading of the SRL by catalytic hydrogenation to a synthetic crude oil. The report covers the investigation of lignite liquefaction in a batch autoclave system, in a 50 lb/h Process Development Unit (PDU) and additionally covers a series of economic studies of the technology developed. The PDU was operated for thirty-two runs covering 1870 hours actually processing lignite under various conditions of pressure, temperature and throughput. A description of the unit is presented together with a typical material balance and yield structure.

18330 (FE—2202-51) **Homogeneous catalytic hydrocracking processes for conversion of coal to liquid fuels: basic and exploratory research. Quarterly report, September 16, 1979-December 15, 1979.** (SRI International, Menlo Park, CA (USA)). 1979. Contract EX-76-C-01-2202. 15p. Dep. NTIS, PC A02/MF A01.

The objective of this work is to determine the major chemical features of the catalytic activity in our CO-blue-water system and to make a preliminary investigation of its potential for coal upagrading. (Blue-water is the neutralized water recovered from a previous CO/H_2O/KOH reaction and contains substantial quantities of transition metals leached from the autoclave). We will study the nature of blue-water catalysis and test its effectiveness with CO and H_2. Catalyst candidates of selected transition-metal salts will be similarly tested. Some effort will be spent on determining recovery and recyclability of the catalyst. We have determined that blue-water catalysis is not due to coal-derived components, and we have ruled out any major involvement of formate. Thus, we believe that the activity of blue-water is due to its transition-metals content. Also, blue-water catalysts is less effective in the presence of H_2 than CO. Atomic absorption spectroscopy of several blue-water samples indicated four metals of particular interest; Mo, Fe, Ni, and Cr. In initial tests of Mo, Fe, and W, we discovered an effective coal conversion catalyst - Na_2MoO_4. Like blue-water, Na_2MoO_4 is more effective with CO than with H_2. A run with 0.3% Mo as Na_2MoO_4 in H_2O with CO provided a 50% benzene-soluble product from Ill. No. 6 coal at 400°C for 20 min. In an initial attempt to recycle Mo-containing water, we found most of the Mo to be in the benzene-insoluble product fraction rather than still dissolved in the water.

18331 (FE—2244-26) **Flash pyrolysis coal liquefaction process development. Final report, July 1976-June 1978.** Che, S.C.; Duraiswamy, K.; Knell, E.W.; Lee, C.K. (Occidental Research Corp., Irvine, CA (USA)). Apr 1979. Contract EX-76-C-01-2244. 184p. Dep. NTIS, PC A09/MF A01.

This is the final report of the work performed by Occidental Research Corporation (ORC) on Flash Pyrolysis Coal Liquefaction Process Development. In this program, a specially-designed, proprietary, caking coal reactor was demonstrated to process caking coals without oxidative pretreatment. Tar yields of about 35 wt % MAF were achieved in a 3 ton-per-day process development unit (PDU) from Western Kentucky No. 9 seam bituminous coal, and tar yields of about 22 wt % MAF were achieved from Wyoming Monarch seam subbituminous coal at a reactor residence time of about 1.5 seconds and a temperature of about 1200°F. These tar yields were about twice that obtainable for the same coals by Fischer Assay testing or by the fluidized bed pyrolysis processes (such as COED) with long residence times. The hydrorefining processability of the pyrolysis tar was demonstrated using a continuous hydrotreater. Two major technical problems were encountered and solved during this program: (1) the initial PDU tar yield results were low compared to projections from the bench scale reactor (BSR), and (2) poor char rate control severely limited the PDU reactor operability. Tar cracking on the excessively active surfaces of the recycle char was identified as the cause for the lower tar yield in the PDU. By using reactive char transport gases such as CO_2 and H_2O rather than N_2, the tar yield from PDU was increased to the same level as BSR. The tar yield was also increased by using less reactive solid heat carriers such as nonporous alumina or petroleum fluid coke. The char rate control problem was solved by the development and the use of a novel lift-tube char feeder in the place of a mechanical screw feeder.

18332 (FE—2270-46) **Solvent refined coal (SRC) process operation of solvent refined coal pilot plant. Annual report, January-December 1978.** Lewis, H.E.; Weber, W.H.; Usnick, G.B.; Hollenack, W.R.; Blair, H.O.; Boykin, R.G. (Catalytic, Inc., Wilsonville, AL (USA); Southern Co. Services, Inc., Birmingham, AL (USA)). Oct 1979. Contract EX-76-C-01-2270. 227p. Dep. NTIS, PC A11/MF A01.

Operating conditions and test results obtained at the six-ton-per-day Solvent Refined Coal (SRC) pilot plant in Wilsonville, Alabama, are summarized. Two coals were processed. The effects of process variables on SRC yield and solvent quality were investigated. These variables included space rate, coal mineral concentration in the dissolver, hydrogen partial pressure, and temperature. A system for continuously withdrawing a portion of the dissolver contents was operated to investigate the effects of minimizing the concentration of solids in the dissolver. Tests confirming the high rate of coal conversion at short residence time were completed. Several methods of deashing the low pressure reaction product were tested: pressure-leaf filtration, centrifugation with antisolvent addition, and 10 mm hydroclones with antisolvent addition. Both horizontal and vertical pressure-leaf filtration units were tested. Filter aids such as perlite, fly ash, and several grades of diatomite were used. Operating without precoat was also studied. A proprietary method of deashing liquid SRC was also tested. The system (developed by Kerr-McGee Corporation) employs an extraction technique in conjunction with a proprietary solvent which operates near critical conditions. The effect of SRC process conditions and CSD operating conditions on SRC recovery was studied. Several tests were also made to optimize the conditions for recovering process solvent containing light SRC.

18333 (FE—2454-7) **Studies in coal liquefaction with application to the SRC and related processes. Quarterly report, January-March 1978.** Guin, J.A.; Tarrer, A.R. (Auburn Univ., AL (USA). Coal Conversion Lab.). 1978. Contract EX-76-S-01-2454. 108p. Dep. NTIS, PC A06/MF A01.

This report describes work done to better understand and improve the Solvent Refined Coal and related liquefaction processes. A new, short-residence-time, catalytic, two-stage SRC process has been evaluated. Two stage catalytic SRC processing was found to be more selective for desulfurization than (catalytic or non-catalytic) single stage SRC processing, by using low reaction temperature, short residence times, the ash of SRC residue as a first stage catalyst, and Co-Mo-Al as a second stage catalyst. Coal minerals were again observed to be strongly involved in rehydrogenation of solvent and in hydrogenation of coal-derived liquid products, and in liquefaction studies using physically separated coal samples from Pittsburgh Energy Research Center. In the presence of about 3% CaO, the liquefaction yield was lowered about 20 to 30%. CaO inhibited the coal liquefaction reaction in that it reduced the hydrogen transfer reaction-hydrogenation (based on benzene solubles). Representative coal minerals such as Fe, pyrite, and SRC residue ash showed significant catalytic activity in hydrodenitrogenation of benzonitrile to toluene (about 30 to 40% conversion). Six arbitrary fractions of the THF soluble portions of SRC were obtained by the GPC elution and were characterized by using various instrumental analyses such as HPLC, GC, MS, Fluoroescence and uv spectroscopy, and FTIR. Separate abstracts were prepared for two sections.

18334 (FE—2454-7, pp 63-93) **Appendix: short residence time catalytic two-stage SRC process.** Garg, D.; Tarrer, A.R.; Guin, J.A.; Lee, J.M.; Curtis, C. (Auburn Univ., AL). 1978.

In Studies in coal liquefaction with application to the SRC and related processes. Quarterly report, January-March 1978.

The ash of SRC residue can be used to selectively catalyze desulfurization over hydrogenation in SRC processing. Selectivity for desulfurization in two stage hydrodesulfurization of coal is improved by using low reaction temperatures, short residence times, the ash of SRC residue as a first stage catalyst, and Co-Mo-Al as a second stage catalyst. Two stage catalytic SRC processing as herein proposed is more selective for desulfurization than (catalytic or non-catalytic) single stage SRC processing.

18335 (FE—2454-7, pp 94-104) **Characterization of solvent refined coal by high pressure liquid chromatography and other analytical techniques.** Hathaway, C.D.; Curtis, C.W.; Meng, S.; Tarrer, A.R.; Guin, J.A. (Auburn Univ., AL). 1978.

In Studies in coal liquefaction with application to the SRC and related processes. Quarterly report, January-March 1978.

GPC clearly shows that the molecular weight distribution of SRC is consistent with SRC being partialy composed of oil and asphaltenes. The fractions, collected from the GPC elution of Amax SRC, are fairly well-defined: fractions 1 to 3 are composed of asphaltenes, fraction 4 is a combination of oil and asphaltenes, and fractions 5 and 6 are oil. The major constituents of fractions 5 and 6 have been identified as mainly three or four condensed ring polynu-

clear aromatics; fraction 6 contains primarily pyrene, and fraction 5 contains three major components - phenanthene, fluoranthene and pyrene. From the experimental evidence, fractions 1 to 4 can be characterized by their bonding type and chromatographic behavior. Fractions 1 and 2 appear to be somewhat polar, high molecular weight compounds dominated by chain structure possibly within an aromatic framework, while fractions 3 and 4 seem to be fairly high molecular weight but essentially non-polar compounds with a more prominent aromatic structure. Future HPLC work is planned to effect more complete separations of the components in fractions 1 to 4 for subsequent compound identification.

18336 (FE—2454-8) **Studies in coal liquefaction with application to the SRC and related processes. Final summary report, July 1976-July 1878.** Guin, J.A.; Tarrer, A.R. (Auburn Univ., AL (USA). Coal Conversion Lab.). 1979. Contract EX-76-S-01-2454. 320p. Dep. NTIS, PC A14/MF A01.

Fundamental aspects of the Solvent Refined Coal (SRC) and other closely related coal liquefaction processes have been investigated to delineate the effects of changes in process operating conditions, equipment configuration, and nature of raw materials upon the kinetics, mechanism, and extent of coal dissolution, heteroatom removal, and hydrogenation. This has been accomplished by developing new process concepts, such as coal mineral catalysis in the SRC I process and a new short residence time catalytic two-stage SRC process, by systematically evaluating process variables, and by applying various analytical techiques, such as Coulter Counter analysis, high pressure liquid chromatography, gel permeation chromatography, gas chromatography, x-ray fluorescence analysis, etc. To characterize the coal liquefaction products. Three distinctive reactors have been used for this purpose: a conventional autoclave reactor, a small tubing-bomb microreactor, and a transparent visual microreactor. Kentucky No. 9/14 coal mixture has been mainly studied along with several other coals such as Illinois No. 6, Pittsburgh No. 8, Monterey, and Amax. The main process variables are: temperature (350 to 450°C), hydrogen pressure (500 to 3000 psig), catalyst, reaction time, and type of coal (pretreatment).

18337 **Surface area variations of coal during solvent extraction.** Medeiros, D.; Petersen, E.E. (Univ of Calif, Lawrence Berkeley Lab). *Fuel;* **58**: No. 7, 531-533(Jul 1979).

Changes in the surface area of a Wyoming sub-bituminous coal with progressive extraction have been investigated. Surface areas were determined from CO_2 adsorption isotherms at 196 K. The changes in the internal structure of this coal are followed by measuring the surface areas of the raw coal and coal subsequent to extraction, using the well known Brunauer-Emmett-Teller method.

18338 **Overview of liquefaction process technology.** Wolk, R.H. (Electric Power Research Inst. Inc., Palo Alto, CA). pp 273-290 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

Many generic problems must be solved before coal liquefaction can be successfully commercialized. On the basis of the information in hand, a number of reasonable engineering approaches are available to deal with each problem area. Cost, not probability of technical success, is the issue. Among the major areas in which concerns exist or which require further optimization are: process flexibility with respect to feed coal; solids liquid separation for processes producing a heavy, low hydrogen product; hydrogen production from residual products; fired slurry heater design criteria; feed slurry mixing temperature; and vacuum tower designs to maximize distillate recoveries and pumps to remove vacuum tower bottoms which are high in solids content. Operation of the large pilot plants during the next few years should provide significant information that can be used to address areas of concern. There is much more to be done in firming up the fundamental assumptions underlying development of various processes as well as the preliminary calculations that have been done which are based on laboratory data. Some sort of governmental action is obviously required if the government concludes that a synthetic fuel industry is in the national interest. Even if a large scale federal commitment to commercialize coal liquefaction was made it could succeed only by diligent actions that simultaneously deal with forseen problems.

18339 **Technical status of the large coal liquefaction programs at the Department of Energy.** Batchelor, J.D. (Dept. of Energy, Washington, DC). pp 317-330 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

Coal snycrudes can be viewed as an excellent refinery feedstock. Once established process technology exists for coal liquefaction based on a combination of demonstration and pioneer plant projects, the option to use the product either as a boiler fuel directly or as a refinery feed is going to be a powerful stimulus to the growth of an industrial syncrude production capacity.

18340 **Development of a two-stage liquefaction process.** Neuworth, M.B. (MITRE Corp., McLean, VA); Moroni, E.C. pp 345-358 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

The Department of Energy is investigating two-stage liquefaction, involving hydroextraction of coal, solvent deashing, and expanded bed catalytic hydrocracking to distillate fuels. The Lummus-Cities Service commercial LC-Fining process is being utilized for the second stage hydrocracking. Standard SRC I and high throughput coal extracts have been converted to high quality naphtha and fuel oil in a prototype LC-Fining unit. A commercial NiMo catalyst was used for periods in excess of 30 days with modest catalyst deactivation. Hydrogen consumption in the two-stage should be comparable with other direct liquefaction processes.

18341 **Rocket reactor technology applied to coal conversion.** Ubhayakar, S.K.; Oberg, C.L.; Combs, L.P.; Friedman, J. (Rockwell International, Canoga Park, CA). pp 407-437 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

This paper highlights the application of rocket reactor technology to coal conversion, and is based on the work performed under ERDA/DOE-sponsored programs since 1975. Several features of rocket engines lend themselves to adaptation to coal conversion devices, as illustrated here with particular reference to the hydroliquefaction and hydrogasification reactors under development at Rockwell Internaional. Among these features, the ability of rocket engine injectors to mix reactants quickly and efficiently in relatively small volumes is of paramount importance in effectively converting pulverized coal and hot hydrogen into useful liquid and gaseous products, such as Syncrude, BTX, and methane, directly in a single-stage reactor. Experiments to date have shown that the rocket-derived, entrained-flow hydropyrolysis reactor can essentially be tuned to produce product mixes ranging from primarily hydrocarbon liquids to primarily methane. Another offshoot of rocket reactor technology has been the development of the dense phase transport of pulverized coal which enables coal to be transported through tubes, as if it were a liquid, with transport gas flow rates as low as 0.1 wt % of the coal flow rate. The use of a minimal amount of transport gas reduces significantly the parsitic heat losses and the unwanted dilution of the products inherent to conventional fluidized transport of pulverized coal. The foregoing features as well as others are illustrated with the help of data obtained in cold-flow mixing experiments, and in 1/4 and 1 ton-per-hour hydropyrolysis reactor tests.

18342 **Coal conversion through riser cracking.** Duncan, D.A.; Beeson, J.L.; Oberle, R.D. (Inst. of Gas Tech., Chicago, IL). pp 439-460 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

Research and development of short residence time hydropyrolysis of coal has been under way for the past 3 years. A bench-scale unit (BSU) with a high degree of temperature profile control has been operated to generate parametric data. Temperatures of 1300° to 1500°F and operating pressures of 500 to 2000 psi have been used to process coals at residence times of 2 to 8 sec at hydrogen/coal weight ratios of 0.1:2.0. Oil yelds of 13% to 15% of feed carbon have been obtained from North Dakota lignite at approximately 50% carbon conversion; oil yields of about 18% of feed carbon have been obtained under similar conditions from bituminous coals. About half of the liquids are in the C_6 to 400°F boiling range and are mostly monoaromatic. In processing, heavy tars are not produced, and the char is a free-flowing dry solid. A process development unit (PDU) has just been completed; it is a small-scale prototype of the reaction system of the IGT commercial concept called Riser Cracking of Coal. The prospects for this type of processing continue to look promising. A high degree of flexibility in the oils composition with varying reactor temperature profile (holding the same reactor outlet temperature) has been demonstrated, and the product spectrum itself (methane, ethane, gasoline, and fuel oil) is both valuable and needed. The potential stumbling blocks are the cost of making and recycling hydrogen in the process, achieving extended operation with bituminous coals, and the institutional problems inherent in the multiproduct yields.

SOLVENT EXTRACTION

18343 **Change in physical characteristics of Roland Seam coal with progressive solvent extraction.** Harris, E.C. Jr.; Petersen, E.E. (Univ of Calif, Lawrence Berkeley Lab). *Fuel;* **58**: No. 8, 599-602(Aug 1979).

The physical structure of Roland Seam coal was characterized by studying the surface areas, pore volumes, and pore distribu-

tions of raw and extracted coals. BET surface areas were measured by carbon dioxide adsorption at 195 K and nitrogen adsorption at 77 K. Pore volumes were calculated by the difference in the reciprocals of measured apparent and actual densities. Distribution curves were generated by measuring mercury penetration as a function of pressure. The data gathered suggest a micropore structure having a 3.4 nm average diameter and random constrictions of about 0.4 nm. Extraction generates new micropores and degrades the micropore structure for yields in excess of 30%.

BY-PRODUCTS

18344 Oxidative refining of naphthalene. Rus'yanova, N.D.; Malysheva, N.V.; Grinevich, N.A.; Kogan, B.E.; Koksharov. V.G. *Coke Chem., USSR (Engl. Transl.);* No. 12, 43-46(1977).

Translated from Koks Khim.; No. 12, 32-35(1977).

A new method for refining naphthalene has been developed at VUKhIN; it uses no acid, produces no useless processing wastes and increases the naphthalene yield ratio. In brief, the method consists in treating the naphthalene fraction with ozonized air in the presence of 2 to 3% of an additive (crude anthracene or pitch). The additive enhances the ozone utilization factor, particularly towards the end of the refining cycle. Ozone has a specific action on unsaturated compounds (indole, indene and their derivatives) and the oxidation rate is very high. Under the processing conditions there is no significant reaction between ozone and naphthalene, methylnaphthalenes or thionaphthene. This new naphthalene refining process for Eastern feedstocks produces no plant wastes and gives a product after distillation that can be used for phthalic anhydride production. The oxidative refining process raises the naphthalene recovery ratio to about 92% of that available in the feedstock.

PROPERTIES

REFER ALSO TO CITATION(S) 18335, 18359, 18366, 18367

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 18307, 18356, 18838

18345 (COO—4035-2(Sect.A)) **Comparative study of effluents and their control from four dry ash Lurgi gasification plants. Executive summary.** Somerville, M.H.; Elder, J.L.; Baria, D.N.; Hung, Y.T. (North Dakota Univ., Grand Forks (USA). Engineering Experiment Station). Jul 1978. Contract EY-76-S-02-4035. 37p. Dep. NTIS, PC A03/MF A01.

Any gasification facility generates three classes of waste: solid, liquid, and gaseous. All three classes were investigated in some depth and are discussed. Liquid wastes are controlled in the sense that there are none. There are no waste water streams from any of the facilities with the exception of ANG's deep well which will be used for brine disposal. All of the water is either treated for reuse or evaporated. There is little published data concerning the characteristics of water reuse treatment systems for coal gasification facilities. There is a high probability that the existing technology can be used to meet the zero discharge requirement and provide water for reuse. Gaseous emissions are under tight state standards in New Mexico and federal standards and guidelines in North Dakota. Controlled substances are NO/sub x/, non-methane hydrocarbons (HC), COS, SO_2, CO, and particulates. Hydrocarbon (HC) and carbon-monoxide emissions guidelines and standards (both federal and state) are somewhat easier to meet than the sulfur standards. Solids wastes and sludges are, at this time, uncontrolled. There is, however, significant research being conducted to establish the probable impact of solid waste disposal and to establish techniques to minimize the potential impact.

18346 (COO—4035-2(Sect.B)) **Comparative study of effluents and their control from four dry ash Lurgi gasification plants.** Somerville, M.H.; Elder, J.L.; Baria, D.N.; Hung, Y.T. (North Dakota Univ., Grand Forks (USA). Engineering Experiment Station). Jul 1978. Contract EY-76-S-02-4035. 291p. Dep. NTIS, PC A13/MF A01.

The four coal gasification plants reviewed are the ones proposed by the El Paso Natural Gas Company, the WESCO Gasification Company in New Mexico, the Natural Gas Pipeline Company of America, and the ANG Coal Gasification Company in North Dakota. This study was undertaken in order to review the nature and the amounts of the effluent emitted into the environment, to determine the cost of controlling undesirable effluents, to review water treatment facilities and pollution control technologies, to discover the projected capital and operating costs for the plants, and to identify control technology research needs. The fixed capital investment and the direct operating costs for equipment to control emission of potentially harmful effluents, such as H_2S, SO_2, hydrocarbons, coal dust, particulates, ashes, sludges, COS, CS_2, CO, and H_2 were estimated according to the design information provided by the gasification companies. The reuse water treatment systems were reviewed. The work has revealed that the weakest portions of the designs rest in water reuse and sulfur control technology. In the authors' judgements, there is a good probability that existing technology can be utilized to meet the zero liquid discharge and existing gaseous emission requirements for the proposed gasification facilities with minimal upset. However, the technology for internal water reuse is not well established, and these streams can be expected to have characteristics other than those projected. Stretford and Claus technology for sulfur removal exists and, in our judgement, has a good probability of meeting existing guidelines and regulations. Some operating data are available for high CO_2, low H_2S, streams; these data are not available in the literature at this time. Recommendations for research have been made.

18347 (COO—4035-2(Sect.C)) **Comparative study of effluents and their control from four dry ash Lurgi gasification plants. Supplementary data.** Somerville, M.H.; Elder, J.L.; Baria, D.N.; Hung, Y.T. (North Dakota Univ., Grand Forks (USA). Engineering Experiment Station). Jul 1978. Contract EY-76-S-02-4035. 383p. Dep. NTIS, PC A17/MF A01.

18348 (EPRI-FP—1252) **Coal waste artificial reef program. Phase I .** Woodhead, P.M.J.; Duedall, I.W.; Lansing, N.F. (New York State Energy Research and Development Authority, Albany (USA)). Nov 1979. 74p. Dep. NTIS, PC A04/MF A01.

The overall objective of the Coal Waste Artificial Reef Program is to explore the feasibility of a method for ocean disposal of fly ash and scrubber sludge from coal-fired power plants. The program is to construct an artificial reef in the Atlantic Ocean near Long Island from stabilized blocks of these waste materials. The reef is expected to enhance biological productivity and to provide a location for sport fishing analogous to that enjoyed at the Fire Island artificial reef. The concept is based on investigations conducted by the Marine Sciences Research Center of SUNY, Stony Brook, into the effects of commercially-produced stabilized mixes of fly ash and sludge on the marine environment. The test blocks employ mixes selected on the basis of this prior work. The emphasis has been on measuring the specific effects associated with the particular mixes to be used for the reef. Block development has been pursued to define a process for production of the large blocks planned for the reef. The physical properties of the blocks have been investigated to assess their long term stability. The chemical properties have been evaluated to provide a background for assessment of the probable environmental effect of the blocks in the ocean. An environmental baseline description has been initiated to provide a reference for long-term impacts of the reef. Biological tests have been performed to assess the effects of the reef materials on marine life. The results have been favorable. Large blocks can be produced with sufficient strength and stability to survive in the ocean. No adverse biological effects have been found from the presence of the smaller test blocks at the reef site or from leachates which might result from their presence.

18349 Status of industrial boiler FGD applications in the United States. Tuttle J. (PEDCo Environmental, Inc., Cincinnati, OH). pp 557-576 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

PEDCo Environmental, Inc., under contract to the US EPA's Industrial Environmental Research Laboratory at Research Triangle Park, has been monitoring the status of industrial boiler flue gas desulfurization (FGD) applications since 1976. The information provided in this survey program has been obtained by visits to these industrial FGD sites, and through regular contact with company representatives, process designers, equipment suppliers, and government agencies. This paper summarizes the EPA industrial Boiler FGD Survey report, including: (1) the current (first quarter 1979) status of industrial FGD applications in the US, identifying the number of systems operating, under construction, or in a planning phase; (2) a summary of system suppliers, including the number of systems served, processes offered, and total gas flow treated; (3) a summary of FGD process types currently being implemented, with a discussion of some major installations, including system design and operating experience; and (4) a summary of currently reported costs for the industrial FGD applications.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 18345, 18375, 18828, 18831, 18837, 19345, 19349, 19507, 19549

18350 (DOE/EV—0065) **Environmental issues relating to fossil energy technology options.** (Department of Energy, Washington, DC (USA). Div. of Technology Assessments). Oct 1979. 27p. Dep. NTIS, PC A03/MF A01.

The Office of Fossil Energy has prepared a report on fossil technology options available to reduce oil imports. It identifies energy processes ready for immediate deployment (called first wave) and those that, after further development, would provide substantial benefits over the first wave. The latter (called second wave) technologies could be in commercial use in the late 1980s. The status of environmental readiness for each of these fossil technologies is addressed in this report. Primary environmental concerns and environmental research required concurrent with fossil technology development and commercial operation are described herein and presented in conformance to the organization of the fossil options paper. In instances where environmental issues for related technologies are identical or nearly so, we have attempted to avoid redundancy. Although many environmental concerns have been recognized and are being dealt with for each technology, some areas of concern must receive continued attention. These are briefly mentioned in this introduction. Further details, specific to each technology, are in the appropriate sections of the report. Research is continuing on both health and ecological effects of coal combustion and gasification. Having identified cancer-producing elements in airborne particulates, the Environmental protection Agency (EPA) is developing a standard for respirable range particulates. With regard to the synthetic fuels, one of the major concerns is the health and safety aspects of the coal liquid products. It is known, for example, that some coal-derived liquids that have undergone only minimal processing or upgrading do contain carcinogens. Environmental effects in other fossil energy areas such as oil shale processing, enhanced oil recovery, etc., are discussed.

18351 (PB—80-102551) **Environmental assessment: source test and evaluation report - Wellman-Galusha (Glen Gery) low-Btu gasification. Final report, January 1978-May 1979.** Thomas, W.C.; Trede, K.N.; Page, G.C. (Radian Corp., Austin, TX (USA)). Aug 1979. Contract EPA-68-02-2147. 213p. NTIS, PC A10/MF A01.

The report gives results of a Source Test and Evaluation Program at a commercial coal gasification plant using a Wellman-Galusha gasifier to produce low-Btu fuel gas from anthracite coal. Major objective of the tests was to perform an environmental assessment of the plant's waste streams and fugitive emissions. Results of the chemical analyses of the plant's waste streams indicated that all contained organic and/or inorganic components which may have potentially harmful health and/or ecological effects. In the pokehole and coal hopper gaseous emissions, CO, NH3, and possibly Fe(CO)5 were found to be of major concern. Organic compounds which were not specifically identified were of potential concern in the ash sluice water. The gasifier ash and cyclone dust contained a number of trace elements and possibly organics that may be potentially harmful. Analyses of the leachate from these two solid waste streams indicated that the leachate may have potentially harmful health and/or ecological effects; however, at a substantially lower level of concern when compared with the results of the ash and dust themselves. Overall, the indicated potential health and ecological effects of the plant's waste streams were found to be significantly lower than those for waste streams produced by gasifying bituminous coals.

18352 (PB—80-102791) **Criteria for assessment of environmental pollutants from coal cleaning processes. Final report, September 1976-April 1979.** Ewing, R.A.; Cornaby, B.W.; Van Voris, P.; Zuck, J.C.; Raines, G.E. (Battelle Columbus Labs., OH (USA)). Jun 1979. Contract EPA-68-02-2163. 202p. NTIS, PC A10/MF A01.

The report describes the development of criteria for assessing environmental pollutants associated with coal cleaning processes. The primary problem concerns emissions of pollutants to all three media--air, water, and land--and assessing their effects on humans and the environment. Pollutants associated with coal cleaning are primarily inorganic compounds associated with the ash fraction. Lists of potential pollutants from coal cleaning and utilization, containing hundreds of entries, have been proposed. Selected for investigation were 51 elements and 23 substances or groups of substances. The major criterion for ranking the importance of any pollutant is the relationship between its expected environmental concentration and the maximum concentration which presents no long-term hazard to humans or biota. Environmental concentrations depend on emission rates and the effects of physical transport and dispersion. Although these data will ultimately come from field measurements, for now they must be estimated. Methodology for these estimates are reviewed; the methodology is well developed and little further development appears necessary. Ecological transport and distribution is much less well developed: investigation shows large data gaps for many elements and species. Illustrative data are presented for eight of the more important trace elements.

18353 (PNL-SA—7547) **Atmospheric trace element pollutants from coal combustion.** Smith, R.D.; Campbell, J.A.; Felix, W.D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1979. Contract EY-76-C-06-1830. 15p. (CONF-790219—15). Dep. NTIS, PC A02/MF A01.

From AIME annual meeting; New Orleans, LA, USA (18 Feb 1979).

In summary, analyses have been obtained for approximately 60 elements for sized flyash particles from two coal-fired steam plants. Evaluation of data from the elemental analyses, including the concentration dependence upon particle size, electron microscopy, ESCA, and mass spectrometry suggests a mechanism for formation of the submicron particles in some coal-fired plants. This mechanism involves bursting of larger particles during gas expansion and production of a very large number of very small particles which ultimately form particles in the 0.1 μm to 1.0 μm size range by coagulation. The condensation of volatilized material would then proceed concurrently with the bursting and coagulation process. The factors which determine the volatility of trace elements during coal combustion have been examined. While the organic affinities of individual trace elements in coal are likely to play a role, we have been unable to obtain clear verification of this point in initial studies.

18354 (PNL-SA—7553) **Needed research on the terrestrial effects of coal gasification and liquefaction technologies.** States, J.B.; Harris, W.F.; Haug, P.T.; Kingsbury, G.; Preston, E.; Risser, P.; Scott, R.; Small, R.; Stevens, D.; Taylor, J.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1979. Contract EY-76-C-06-1830. 66p. (CONF-7808121—1). Dep. NTIS, PC A04/MF A01.

From Workshop on environmental research needs for coal liquefaction/fasification technologies; Leesburg, VA, USA (Aug 1978).

The Terrestrial Effects panel discussed the needed direction and techniques for future research in the terrestrial effects of new coal conversion technologies. Panel members concurred on the need for changes in emphasis, approach, and even attitude in environmental research. The following are the basic perceptions of the panel: Our goal is to provide for environmentally amenable technologies in coal conversion and product distribution, especially focusing on pollutants entering pathways to man. Highest research priority, therefore, should be given to solid wastes, and especially their leachates. A shift in research emphasis is needed. Whereas we have been accustomed to investigating acute effects of pollutants immediately surrounding their source, we should now explore the sublethal, long-term effects of pollutants carried farther from their source. These may in fact become the more dangerous of the two through bioconcentration. Research of this kind should help us to predict deleterious effects before they are felt. Another needed reverse in typical environmental research strategy is to perform biological characterization before source characterization. Time for the needed research is running out. In order to make meaningful progress within a short time frame, we will have to narrow the focus of our research to include only the most serious effects and only their most likely causes. To investigate these, just a few best alternative modes of operation could be selected and then constructed on a full commercial scale. Perhaps more than ever before, cooperation between disciplines is essential. Ecologists, biologists, engineers, and statisticians must pool their knowledge and ideas in solving these problems. The panel was encouraged by the success of their own cross-disciplinary efforts as reflected in this summary.

18355 (UCRL—52847) **Distribution of neutral organic reaction by-products in the groundwater at an underground coal gasification site.** Stuermer, D.H.; Ng, D.J.; Morris, C.J.; Cotton, A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1979. Contract W-7405-ENG-48. 18p. Dep. NTIS, PC A02/MF A01.

Investigations of the composition and distribution of neutral organic compounds in groundwater from a series of wells within and near an underground coal gasification site over a 15-mo period suggest that the neutral compounds of concern are a series of low-molecular-weight, water-soluble aromatic hydrocarbons. These compounds are apparently dissolved from a more complex mixture of hydrocarbons in by-product tar deposited in the aquifer substrate. Evidence for transport of the low-molecular-weight aromatic hydrocarbons in the groundwater is presented. A series of heterocyclic sulfur compounds is observed within the gasification cavity, but these do not seem to be transported in the groundwater system.

18356 (UCRL—84075) **Environmental controls for underground coal gasification: ground-water effects and control technologies.** Mead, W.; Raber, E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Mar 1980. Contract W-7405-ENG-48. 18p. (CONF-800334—2). Dep. NTIS, PC A02/MF A01.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

Underground coal gasfication (UCG) promises to provide economic access to an enormous deep-coal resource. It is, therefore, of considerable importance to develop appropriate environmental controls for use in conjunction with the UCG process. The Lawrence Livermore Laboratory has conducted three UCG experiments

at its Hoe Creek site in northeastern Wyoming. Environmental studies are being conducted in conjunction with these UCG experiments, including an investigation of changes in local ground-water quality and subsidence effects. Ground-water monitoring and geotechnical measurements have helped to clarify the environmental significance of reaction-product contaminants that remain underground following gasification, and the implications of cavity roof collapse and aquifer interconnection. These investigations have led to the development of preliminary plans for a specific method of ground water quality restoration utilizing activated carbon adsorption. Unconventional technologies are also being investigated that may be appropriate for restoring ground water that has been contaminated as a result of UCG operations. These water treatment technologies are being explored as possible supplements to natural controls and process restrictions.

18357 Land reclamation at abandoned deep coal mine. Wilkey, M.; Zellmer, S. (Land Reclam Program, Argonne National Lab, Ill). *J. Environ. Eng. Div., ASCE;* **105**: No. 5, 843-853(Oct 1979).

A typical abandoned midwestern deep coal mine site was selected, final land use determined, baseline environmental data collected, engineering plans developed and implemented, and a post-construction evaluation begun. The project is a cooperative effort by two state agencies --the Abandoned Mined Land Reclamation Council of Illinois and the Illinois Institute of Natural Resources --and the U.S. Department of Energy through the Land Reclamation Program at Argonne National Laboratory. Site development included recontouring 23 acres of the 33.95 acre site. Cover material was applied to the recontoured areas which were then limed, fertilized, and seeded with a mixture of grasses and legumes. A pond was constructed to control runoff and to provide a combined wildlife and recreational area. After two growing seasons vegetation has been established and on-site water quality has shown significant improvement.

MINING

REFER ALSO TO CITATION(S) 18371

18358 (DOE/EIA—0118(77)) **Bituminous coal and lignite production and mine operations-1977. Energy data report.** Boykins, C. (Department of Energy, Washington, DC (USA). Energy Information Administration). 21 Dec 1979. 86p. Dep. NTIS, PC A05/MF A01.

This report is primarily a compilation of tables and illustrations that detail various aspects of bituminous coal and lignite production and mine operations in the United States in 1977. It covers such basic sectors as production tonnages, mining methods, employment, productivity, coal preparation, values, shipments, and coalbeds mined during the year. The data are from mines that produced 1000 tons or more. All production tonnages represent marketable coal and as such exclude refuse. In 1977 bituminous coal and lignite production reached an all time high of 691.3 million tons, surpassing by almost 2 percent the previous record of 678.7 million tons in 1976. Production from underground mines totaled about 266.0 million tons, down 9.8 percent from 294.9 million tons the previous year. Surface-mined production rose 10.8 percent to 425.4 million tons from 383.8 million tons in 1976. Coal was produced in 25 States. The leading coal-producing States were Kentucky, West Virginia, Pennsylvania, Illinois, Ohio, Wyoming, and Virginia. Together, these States accounted for 74 percent of the total US coal production. The Appalachian Region continued to be the major coal producing region, accounting for 393.8 million tons or 57.0 percent of the total production. In December 1977, production declined sharply when the 1974 contract between the United Mine Workers of America (UMWA) and the Bituminous Coal Operators Association (BCOA) expired and about 160,000 active UMWA members went on strike. By the end of 1977, all BCOA mines and about 60 percent of all other coal mines were idle because of picketing or sympathy strikes.

18359 (FE—1231-18) **Design optimization in underground coal systems Sections 1, 2, 3, and 4. Interim report, July-September 1979.** Breeds, C.; Haycocks, C.; Karmis, M.; Topuz, E. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Mining and Minerals Engineering). Nov 1979. Contract EX-76-C-01-1231. 66p. Dep. NTIS, PC A04/MF A01.

This report covers three areas: (1) sampling of coal and measurement of its mechanical properties (effects of sample size and shape, rate of loading, etc.); (2) longwall mining (implications of geology and stratigraphy for strata control and mine design, and economic analysis (optimization of face length)); and (3) roof truss studies (literature review, photoelasticity studies on PSM-4 or polyurethane models and correlations of experimental data with beam theory). (LTN)

18360 (FE—9110-1(Vol.1)) **Operating guidelines for dragline stripping operations; analysis of tandem systems. Final technical report as of 31 August 1979.** Cook, F.; Lappi, R.L. (Mathtech, Inc., Princeton, NJ (USA)). Oct 1979. Contract ET-77-C-01-9110. 157p. Dep. NTIS, PC A08/MF A01.

Practical guidelines for choice of dragline block length, bench height, pit width, and dig/cast patterns are developed for single seam, dragline-based hillside and hilltop stripping operations in northern and southern Appalachia. They are based on interviews of 45 dragline operators and computer analysis of dragline cycle time data for almost 10,000 cycles for 20 draglines in four states. The factors affecting philosophies and decisions are documented. Analyses of observed dozer/dragline mining operations determined that the observed operations are not true tandem systems utilizing the production capability of dozers in a systematic manner. Models are constructed to analyze the potential of tandem dozer/dragline systems and tandem loader/truck/dragline systems. Conclusions are that significant productivity and cost benefits may be available with deep dozer benching, particularly for small dragline operations. Loader/truck/dragline systems provide capability for deeper digging than is possible with a dragline alone or with a dozer/dragline system, but do not appear economically competitive within the operating range of a dragline or a dozer/dragline system.

18361 (FE—9110-1(Vol.2)) **Operating guidelines for dragline stripping operations; analysis of tandem systems. Final technical report as of 31 August 1979. Volume II. Appendices.** Cook, F.; Lappi, R.L. (Mathtech, Inc., Princeton, NJ (USA)). Oct 1979. Contract ET-77-C-01-9110. 348p. Dep. NTIS, PC A15/MF A01.

Pracical guidelines for choice of dragline block length, bench height, pit width, and dig/cost patterns are developed for single beam, drag-line based hillside and hilltop stripping operations in northern and southern Appalachia subject titles for appendices are: description of field procedures, explanation of data analysis techniques; statistical backup for operator differences; calculation of effects of poor shooting on dragline productivity; models and assumptions used to estimate dragline production rates in single beam stripping; procedure for estimating the effects of dragline walking time on dragline productivity; frequency of occurrence of dragline activities; dragline production rate estimates; the horseshoe method - a model and case study; and model and case study; for the extended bench method of 2-seam stripping. (DC)

18362 (PB—297306) **Development of concepts for surface mining moderately pitching coal seams, volume I. summary volume. Final report, 1 October 1977-31 March 1978.** Costello, B.C. III; Gunnett, J.W.; Loy, M.D. (Skelly and Loy, Harrisburg, PA (USA)). 1 Nov 1978. Contract J0275023. 108p. NTIS, PC A06/MF A01.

This report presents the findings of a study aimed at documenting operational problems associated with the surface mining of coal dipping 8 degrees to 25 degrees. Based on an intense literature search and field investigations, new extraction concepts were generated as a means to alleviate these problems. Also contained in the report is a detailed characterization of moderately pitching coal seams found within the United States.

18363 (PB—297307) **Development of concepts for surface mining moderately pitching coal seams, volume II. appendix volume. Final report, 1 October 1977-31 March 1978.** Costello, B.C. III; Gunnett, J.W.; Loy, M.D. (Skelly and Loy, Harrisburg, PA (USA)). 1 Nov 1978. Contract J0275023. 215p. NTIS, PC A10/MF A01.

This report presents the findings of a study aimed at documenting operational problems associated with the surface mining of coal dipping 8 degrees to 25 degrees. Based on an intense literature search and field investigations, new extraction concepts were generated as a means to alleviate these problems. Also contained in the report is a detailed characterization of moderately pitching coal seams found within the United States.

18364 Dust retardant cures mine-mouth Coal-haul problem. Ross, J.L. (Bridger Coal Co., Rock Springs, WY). *Electr. World;* **189**: No. 5, 65(1 Mar 1978).

A road dust-retardant program at Bridger Coal Co., a utility-owned coal mine in Rock Springs, in southwestern Wyoming, has achieved several significant advantages: it has resolved a potentially troublesome dust-laden air problem for area residents and coal-truck drivers; it has significantly reduced the labor and spray-vehicle operating time when compared with the previously used, ineffective water-wetting down dust-control method; it has eliminated the need for additional spraying vehicles, despite expansion of mining operations; and it has the amount of local water needed for spraying. Bridger engineers first sought to alleviate the conditions with water, available from a waste-water reservoir located about 1/2 mile from the plant. Although it was applied virtually nonstop by spreader trucks, the water was unable to control the clouds of vehicular dust. Seeking a more effective answer to the problem, Bridger engineers turned to Coherex, a dust-retardent agent. A cold-water emulsion of selected petroleum resins, Coherex was tested at various dilution rates on the main-haul read and the network of access roads. Tests showed that applications of a 15% Coherex solution penetrated the road surface to a depth of about 1/2 in. The agent agglomerated the

surface dust into larger particles, which could not readily become airborne. And it was found that the slightly acidic wastewater from the local reservoir was compatible with the dust retardant.

TRANSPORT AND HANDLING

18365 (EPA—600/7-79-149) **Washability characteristics of Arkansas and Texas lignites: report of investigations.** Cavallaro, J.A.; Baker, A.F. (Department of Energy, Pittsburgh, PA (USA). Pittsburgh Energy Technology Center). Jun 1979. 52p. Dep. NTIS, PC A04/MF A01.

This report describes the washability characteristics of eleven channel samples of lignite, four from Arkansas and seven from Texas. Only two of the samples, those collected from Dallas County, Arkansas, could be upgraded to meet the current EPA new source performance standard (NSPS) of 1.2 pounds SO_2/MM Btu. The other nine samples, although averaging only a little over 1 percent total sulfur, were relatively high in organic sulfur considering their low Btu/lb value, and could not be upgraded to meet the standard. Physical coal cleaning of these samples, however, provided significant ash reduction which may reduce boiler fouling. It was demonstrated that much of the sodium can be removed from these Arkansas and Texas lignites by ion exchange. Analyses showed 37 to 91% sodium oxide reduction after treatment with a solution containing calcium ions.

18366 (FE—2475-25) **Coal grinding technology: a manual for process engineers.** Luckie, P.T.; Austin, L.G. (Kennedy Van Saun Corp., Danville, PA (USA)). 1980. Contract EX-76-C-01-2475. 98p. Dep. NTIS, PC A05/MF A01.

The beneficiation and utilization of coal requires that mined coals undergo progressive degrees of size reduction. The size reduction process actually starts with the mining of the coal, and the top size and size consist of the mined coal is dependent upon the type of mining system employed. The mined coal undergoes primary breakage in crushers where the top size is reduced to the range of 8" to 3". Either during the processing of the mined coal, or, frequently, before the utilization of the coal, the coal undergoes secondary crushing where the top size is reduced to the range of 2" to 1 1/4". At this stage the coal may also be sized in order to produce special marketable fractions. For final utilization and for treatment by some of the newer beneficiation techniques, the top size of the coal is often further reduces. Then the coal undergoes pulverization which reduces the top size to 1/8" and/or grinding which reduces the top size to 1 mm or less. This handbook examines the intermediate and fine grinding of coal. Four coal grinding devices - three dry, one wet - are discussed with the appropriate ancillary equipment for complete systems. The mills examined are the: air-swept ball mill, roll or ball and race types of mills, air-swept hammer mill, and wet overflow ball mill. The handbook is not intended to be an exhaustive guide to design and practice since separate books could be written on each system. Instead it is a guide for the process engineer who must select a coal grinding system as part of a larger coal conversion system. As a result, the emphasis is upon the product size consist and energy consumption as a function of type of coal and starting size consist. The handbook is the product of a coal grinding study conducted for the Department of Energy (ERDA/DOE) by the Kennedy Van Saun Corporation. It is intended to update this manual periodically and make it more useful by including new information and improving the quality of data included.

18367 (FE—2722-7) **Effects of minerals on coal beneficiation processes. Quarterly report No. 7, April 1-June 30, 1979.** McMillan, B.G.; Muter, R.B.; Buttermore, W.H.; Grady, W.C.; Alderman, J.K.; Simonyi, T.; Gierl, D. (West Virginia Univ., Morgantown (USA). Coal Research Bureau). 15 Sep 1979. Contract EF-77-S-01-2722. 36p. Dep. NTIS, PC A03/MF A01.

This report continues the documentation of detailed characterization of both raw and prepared fractions of coal feeds, products, and refuse from preparation plants in northern West Virginia, southern West Virginia, and central Illinois. It also documents the continuing modifications and additions to the pilot scale preparation plant and the installation and initial operation of two recently acquired instruments, i.e., a Scanning Electron Microscope and an X-Ray Powder Diffractometer. These units are both operable at this time, although quantitative/semi-quantitative capabilities are still being refined. Other areas where significant work was achieved include froth flotation of Pittsburgh, Pocahontas No. 3, and Illinois No. 6 samples and the quantitative determination of kaolinite using IR. This work is documented herein. Additionally, major and minor elemental analysis of samples is on-going.

18368 (ORNL/TM—6929) **Survey and conceptual flow sheets for coal conversion plant handling-preparation and ash/slag removal operations.** Zapp, F.C.; Thomas, O.W.; Silverman, M.D.; Dyslin, D.A.; Holmes, J.M. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 235p. Dep. NTIS, PC A11/MF A01.

This study was undertaken at the request of the Fossil Fuel Processing Division of the Department of Energy. The report includes a compilation of conceptual flow sheets, including major equipment lists, and the results of an availability survey of potential suppliers of equipment associated with the coal and ash/slag operations that will be required by future large coal conversion plant complexes. Conversion plant flow sheet operations and related equipment requirements were based on two representative bituminous coals - Pittsburgh and Kentucky No. 9 - and on nine coal conversion processes. It appears that almost all coal handling and preparation and ash/slag removal equipment covered by this survey, with the exception of some coal comminution equipment, either is on hand or can readily be fabricated to meet coal conversion plant capacity requirements of up to 50,000 short tons per day. Equipment capable of handling even larger capacities can be developed. This approach appears to be unjustified, however, because in many cases a reasonable or optimum number of trains of equipment must be considered when designing a conversion plant complex. The actual number of trains of equipment selected will be influenced by the total requied capacity of the complex, the minimum on-line capacity that can be tolerated in case of equipment failure, reliability of specific equipment types, and the number of reactors and related feed injection stations needed for the specific conversion process.

18369 (PB—295683) **EPA-interagency coal cleaning program: fy 1978 progress report. Final report, October 1977-September 1978.** Tems, R.D. (PEDCo Environmental, Inc., Dallas, TX (USA)). Feb 1979. Contract EPA-68-02-2603. 113p. NTIS, PC A06/MF A01.

Research and development activities under the interagency coal cleaning program are responsive to changing regulatory requirements and energy goals. A review of current regulatory activities and the status of coal cleaning technology provides the context for discussion of progress on recent coal cleaning research and development.

18370 (PMTC—7(80)) **Evaluation of collector addition in the flotation of various US coals.** Miller, K.J. (Department of Energy, Pittsburgh, PA (USA). Pittsburgh Mining Technology Center). Jan 1980. 34p. Dep. NTIS, PC A03/MF A01.

Laboratory flotation tests were conducted with coals obtained from six coalbeds in the United States to determine the value of using oily collectors, such as fuel oil or kerosine, along with a frother as routine procedure in coal flotation circuits. In order to improve our capability for measuring small differences in the test results and to assure greater reproducibility, a modified laboratory flotation cell with mechanical froth scrapers was fabricated and adapted to a conventional laboratory flotation machine. The results of the flotation study showed that clean coal yield, product quality and, in some cases, coal flotation rate and froth solids concentration are affected by the presence of oily collector in the pulp. In general, the test results showed that the collector may be either helpful or harmful depending on the natural floatability of the coal. That is, the very floatable deep-mined Appalachian region coals did not benefit by collector addition within the reagent dosage range used in this work. Generally, clean coal yield was no better than that obtained with a modicum of frother along while product quality, in terms of ash and sulfur content, deteriorated. Poorly floatable coals, on the other hand, benefited by collector addition. Less of the relatively costly frother was required to obtain equal clean coal yield and product quality.

18371 **Breaking bottlenecks at the face with continuous haulage.** Mayercheck, W.D. (US DOE, Pittsburgh Min Technol Cent, Pa). *Min. Eng. (N.Y.)*; 31: No. 7, 788, 790-792, 795(Jul 1979).

Since it appears that no one type of coal haulage system is universally applicable to all underground mining conditions, the US Bureau of Mines in 1975 began a long term effort to investigate continuous haulage concepts that would provide operating alternatives in various coal mining conditions. Following creation of the Department of Energy (DOE), this program work was transferred from the Bureau to DOE in October 1977. Besides the large RandD effort devoted to hydraulic pipeline transport of coal underground, DOE has funded numerous other continuous haulage projects in both room-and-pillar and shortwall mining plans. This article focuses on those developments that are most topical or have progressed to a hardware stage.

COMBUSTION

REFER ALSO TO CITATION(S) 18307, 18327, 18384, 18385, 18825, 18828, 18837

18372 (ANL/ECT—6) **Assessment of the status of fluidized-bed combustion based on the papers of the Fifth International Conference: methodology and results.** (Mitre Corp., McLean, VA (USA).

METREK Div.; Argonne National Lab., IL (USA)). Dec 1979. Contract W-31-109-ENG-38. 400p. Dep. NTIS, PC A17/MF A01.

This report constitutes a status assessment of fluidized-bed combustion power-generation technology undertaken as part of an ongoing program sponsored by the US Department of Energy's Division of Environmental Control Technology under the Assistant Secretary for Environment. The study, based on the papers presented at the Fifth International Conference on Fluidized-Bed Combustion in 1977, was prepared by the MITRE Corporation, with support from Argonne National Laboratory. Information abstracted from the papers was categorized according to various technical considerations and summarized. Issues and problems associated with the technology were identified from these summaries. These issues and problems, with any associated information gaps, were ranked in terms of their significance, taking into account the needs of potential users of the technology. The resulting data base is presented in a series of matrices showing concentrations of activity, reported information, issues and problems, and relative significance. Areas in which further investigation is required, as indicated using this methodology, include selection, preparation, feeding, and utilization of fuel and sorbent; disposal of solid wastes; heat transfer; emissions control; optimization of operating parameters and control procedures; corrosion and erosion of construction materials, and equipment configuration.

18373 TVA programs on atmospheric fluidized bed combustion (AFBC). Mayfield, M.J. (Tennessee Valley Authority, Chattanooga, TN). pp 599-614 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

In September 1976, the TV Board approved Phase I of a program leading to the design and construction of an atmospheric fluidized bed combustion (AFBC) demonstration power plant. The objective was to prepare a preliminary design and cost estimate on which to base decisions for proceeding to subsequent phases and for initiating planning necessary to undertake a 200 MW AFBC Demonstration Power Plant Program. To obtain the best possible design and to increase involvement of the utility boiler industry in development of the technology, TVA awarded contracts for preliminary design of the steam generator to three leading utility boiler manufacturers: Babcock and Wilcox (B and W), Combustion Engineering, Inc., (CE), and Fluidized Combustion Company (FCC). This paper summarizes and assesses the results of the three preliminary steam generator designs by B and W, CE, and FCC, compares AFBC to the conventional coal-fired utility boiler with wet scrubber, cites the need for hot-gas clean up development before PFBC can be used, and addresses the impact of the proposed New Source Performance Standards on Atmospheric Fluidized Bed Combustion . The preliminry design study of three boiler manufacturers emphasized the need for vigorous R and D in the areas of materials feed and distribution, bed design, and performance correlations, control, and long-term performance data on material corrosion and erosion. There is a good indication that AFBC can effectively meet the EPS's proposed New Source Performance Standards and AFBC can result in eventual savings over a conventional plant with scrubber.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 18828, 18829, 18965

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 18351, 19714

REGULATIONS

18374 (PB—80-106883) The coal-bearing Narragansett Basin of Massachusetts and Rhode Island. Volume 2: legal, economic, environmental, and societal study (LEES). Final report. Rider, T.H. (Weston Observatory, MA (USA)). 1978. 513p. NTIS, PC A22/MF A01.

This report consists of analyses in four areas of nongeological concern: legal, economic, environmental, and societal. The purpose of this volume is to identify institutional barriers which might arise as a result of developing interests in reserve extraction in the Narragansett Basin. Approximately thirty pieces of legislation are analyzed and related to economic, environmental, and societal aspects of mining activity.

18375 (PB—295663) Coal lease tracts in the west - a concise comparison methodology. Final report. Gray, M.E.; Dickson, E.M.; Holt, B.R.; Mara, S.J.; Steele, R.V. (SRI International, Menlo Park, CA (USA). Center for Resource and Environmental Systems Studies). Mar 1979. Contract EPA-68-01-4691. 279p. NTIS, PC A13/MF A01.

A method for comparing the environmental sensitivity of candidate lease tracts is presented in this easy-to-use handbook. The method helps users analyze information on important aspects of tracts proposed for coal leasing in three ways. First, the method organizes information and analysis about individual tracts according to six critical environmental indicators. Second, the analytical results are used to compare and rank order the tracts from least environmentally affected to most severely affected by mining. Finally, the method incorporates the values of various interest groups into the rankings so that different perspectives on the desirability of mining the various tracts can be readily perceived. This method was specifically designed to evaluate surface-mineable coal lease tracts in the West. However, the concept is flexible and could be applied to almost any area after suitable modification of the indicators.

PETROLEUM

GEOLOGY AND EXPLORATION

18376 New data supporting the theory of the sedimentary-migration origin of petroleum. Mitin, S.N. *Dokl. Akad. Nauk SSSR;* **245**: No. 4, 924-926(1979). (In Russian).

A study was made of samples of halite from the upper Jurassic evaporite formations of the Eastern Kuban and Black Forest depressions to test the principal tenets of the theory concerning the sedimentary-migration origin of petroleum. A description is given of the microscopic and recrystallization tests of gas-fluid inclusions in halite which indicate that alumina matter in dispersed states, following a slow process of halite recrystallization, began to generate fluid hydrocarbons so that the presence of areas of hydrocarbons around recrystallized pieces of alumina support the theory of the sedimentary-migration origin of petroleum. 6 references.

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 18429

18377 (DOE/BETC/0037—1) Evaluation of target oil in 50 major reservoirs in the Texas Gulf Coast for enhanced oil recovery. Hicks, J.N.; Foster, R.S. (Department of Energy, Dallas, TX (USA). Energy Information Administration). Feb 1980. 68p. Dep. NTIS, PC A04/MF A01.

This investigation determines the target oil available for enhanced oil recovery (EOR) from 50 major oil reservoirs in the Texas Gulf Coast. A preliminary screening process was used to determine which of five EOR methods, if any, were suitable for each of these reservoirs. Target oil in the 50 reservoirs is estimated to be 4.4 billion barrels of oil unrecoverable under present operating conditions, with about 1.5 billion barrels susceptible to EOR processes. None of the reservoirs have an outstanding potential for thermal recovery; however, seven reservoirs have carbon dioxide miscible flood potential, seven haven surfactant flood potential, and nine have polymer flood potential. None of the five methods was considered suitable for the remaining 27 reservoirs.

18378 (DOE/ET/13070—53) El Dorado micellar-polymer demonstration project. Rosenwald, G.W. (ed.). (Cities Service Co., Tulsa, OK (USA); Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Feb 1980. Contract ET-78-C-03-1800. 242p. Dep. NTIS, PC A11/MF A01.

The micellar fluid injection was completed in the north (Chesney) pattern, and injection of polymer soluttion was initiated. Polymer solution was injected into the south (Hegberg) pattern during the entire reporting period. The third step of the graded polymer injection design is nearing completion. Fluid movement at the observation wells has been monitored closely. Oil mobilization has been indicated by the detection of an oil bank moving past some of the observation wells in both patterns. No significant changes in fluid composition have occurred at the eight production wells during this reporting period. Three flow tests designed to define the optimal salinity for the north pattern polymer drive were made using El Dorado 650-ft Sandstone cores. Results of these tests indicated that a polymer drive with 1.0 wt %. NaCl in El Dorado lake water has the highest oil recovery efficiency. The pressures in the project monitoring wells were measured four times. Two sets of pressure transient tests were conducted to determine the extent of a hydraulic fracture of well MP-213; these tests also involved wells MP-226 and MP-227. An extensive discussion of the west-to-east pressure gradient observed in the field was presented last year. Data indicate the gradient still exists. Computations show that the gradient cannot be

caused by the degree of reservoir heterogeneity thought to exist in the El Dorado reservoir. Although the cause of the gradient remains unexplained, its adverse impact on ultimate oil recovery could be significant and should be considered in future performance modeling. An estimate of recovery efficiency was made based on the updated calculations and the data taken for the one-foot interval at well MP-131. These preliminary results showed about 40% displacement efficiency.

18379 (DOE/ET/13077—36) **Commercial scale demonstration: enhanced oil recovery by micellar-polymer flood. Annual report, October 1978-September 1979.** (Marathon Oil Co., Findlay, OH (USA)). Feb 1980. Contract AC19-78ET13077. 123p. Dep. NTIS, PC A06/MF A01.

During the interim from October 1, 1978, through September 30, 1979, slug injections was completed and injection of polymer spike began.

18380 (ORO—5301-47) **Oil recovery by carbon dioxide injection. Annual report, July 1978-June 1979.** King, P.E. (Pennzoil Co., Vienna, WV (USA)). Nov 1979. Contract EF-76-C-05-5301. 57p. Dep. NTIS, PC A04/MF A01.

After one year of response, the increase in production due to waterflooding ended by December, 1978. The total production credited to the waterflood process was 10,403 barrels or 529 barrels per acre. On February 20, 1979, limited carbon dioxide injection began. Less than a month after injection began, a high carbon dioxide content was found in the produced gas at Shaffer No. 1, apparently as a result of channeling through the Big Lime thief zone. In April, the carbon dioxide injection rate was reduced to a total of 90 tons per day in an attempt to increase the effective injection from 26.7% to the designed 50%. The net carbon dioxide injection was 10,595.50 tons on July 1, 1979, 42.3% of the total to be injected.

18381 (ORO—5602-T1(Vol.1)) **Acquisition, classification, and evaluation of engineering and geologic information and characteristics of West Virginia petroleum reservoirs amenable to enhanced oil recovery technology, particularly carbon dioxide injection. Volume I: methodology and results. Final technical report.** Pease, R.W. (Gruy Federal, Inc., Houston, TX (USA)). May 1979. Contract ET-78-C-05-5602. 112p. Dep. NTIS, PC A06/MF A01.

A study was undertaken with the objectives of: preparing an overall assessment of West Virginia reservoirs as candidates for one or more EOR processes; compiling, synthesizing, and analyzing the geologic/engineering data necessary to evaluate the EOR potential of those reservoirs identified as possible EOR candidates; and evaluating and interpreting the results of ongoing and proposed CO_2 injection field tests in West Virginia. This volume is the final report on the contract study. It presents Gruy Federal's methodology, results, and conclusions organized under the three study objectives listed above.

18382 (PB—297134) **Oil mining, a technical and economic feasibility study of oil production by mining methods. Open file report, April 1977-July 1978.** Edey, A.; Kennedy, B.A.; Readdy, L.A. (Golder Associates, Inc., Kirkland, WA (USA)). Oct 1978. Contract J0275018. 293p. NTIS, PC A13/MF A01.

This report describes work performed and results obtained for the technical and economic feasibility study of oil production by mining methods. The characteristics of oil fields which would make them amenable techniques were identified. An inventory of known U.S. oil fields that offer this potential was collated. This was further divided into fields having potential for underground and surface mining systems development. Several candidate fields that fit particular underground and surface mining system types were then selected. Conceptual mining systems were designed for the selected fields. Five underground and four surface methods were chosen. Costs of oil production were estimated for these selections. The impact of oil mining on the environment was also considered.

18383 (PNL-SA—7352(Vol.1), pp 231-329) **Systematic study of metal ion sorption on selected geologic media. Sesquiannual report, April 1977-September 1978.** Meyer, R.E. (comp.). (Oak Ridge National Lab., TN). 1978.

From 2. contractor information meeting; Seattle, WA, USA (1 Oct 1978).

Results of the first year and a half of a research program on equilibria of inorganic ions between selected minerals and aqueous solutions covering a wide range of composition are summarized. The work is motivated by needs of information for enhanced oil recovery and isolation of nuclear waste, as well as by interest in the fundamental chemistry. A method using an axial filter configuration was adapted to these adsorbents. A technique of supporting clay on filteraid (diatomaceous earth) of low adsorptive properties was developed to allow measurements with columns of dispersible adsorbents, such as montmorillonite. These approaches, which are advantageous under some conditions, were shown to give distribution coefficients (D; adsorbate per weight of clay/adsorbate concentration in equilibrium solution) concordant with values obtained by batch equilibrations. Equilibria of non-hydrolyzed, non-complexed cations and clays were found to be in accord with ion-exchange predictions to a good approximation over a wide range of conditions. As expected on this basis, distribution coefficients of ions present in low concentration declined rapidly as salinity increased. Values of D for many ions at trace levels were the same as at moderate fractional loadings of the ion-exchange capacity. Exceptions were alkali metal ions on the calcium form of montmorillonite, for which decreases of D with loading were found to occur at unexpectedly low loadings, and the dependence of D's of rare earth and actinide (III) ions on salinity, for which a minimum or levelling was found at moderate ionic strength. Adsorption of Cs(I) and Sr(II) on rock samples were much lower from solutions of high salinity than from solutions of low salinity; D-values of Pu, present in unknown species, were erratic.

18384 (SAN—2157-1) **Potential use of California lignite and other alternate fuel for enhanced oil recovery. Phase I and II. Final report.** Shelton, R.; Shimizu, A.; Briggs, A. (Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.). Feb 1980. Contract ET-78-C-03-2157. 152p. Dep. NTIS, PC A08/MF A01.

The Nation's continued reliance on liquid fossil fuels and decreasing reserves of light oils gives increased impetus to improving the recovery of heavy oil. Thermal enhanced oil recovery EOR techniques, such as steam injection, have generally been the most effective for increasing heavy oil production. However, conventional steam generation consumes a large fraction of the produced oil. The substitution of alternate (solid) fuels would release much of this consumed oil to market. This two-part report focuses on two solid fuels available in California, the site of most thermal EOR - petroleum coke and lignite. Phase I, entitled Economic Analysis, shows detailed cost comparisons between the two candidate fuels and also with Western coal. The analysis includes fuels characterizations, process designs for several combustion systems, and a thorough evaluation of the technical and economic uncertainties. In Phase II, many technical parameters of petroleum coke combustion were measured in a pilot-plant fluidized bed. The results of the study showed that petroleum coke combustion for EOR is feasible and cost effective in a fluidized bed combustor.

18385 (SAN—2418-1) **Coal: an alternate fuel for thermal enhanced oil recovery steam generation. Final report.** (McKee (Arthur G.) and Co., Cleveland, OH (USA)). Aug 1979. Contract EX-76-C-01-2418. 86p. Dep. NTIS, PC A05/MF A01.

This project evaluates technical and economic aspects of using coal to replace lower tier crude oil as fuel for thermal enhanced oil recovery steam generation in Kern County, California. Replacing this oil by an alternate fuel would increase the amount of oil available for sale by approximately 30%. The primary consideration in the evaluation is compliance with emission limitations as proposed in the California Air Resources Board (CARB), Model Rule on April 26, 1978. Three coal technolgies were evaluated: coal-oil mixtures, coal gasification, and fluidized bed combustion. coal-oil mixtures and coal gasification were evaluated for retrofit application. Fludized bed combustion was evaluated from the standpoint of providing replacement or future steam generating capacity.

PROCESSING

REFER ALSO TO CITATION(S) 19312

18386 (DOE/EC/01584—1) **Sequential flash (novel) crude distillation.** Mix, T.W.; Dweck, J.S. (Merix Corp., Babson Park, MA (USA)). Jan 1979. Contract EC-76-C-07-1584. 69p. Dep. NTIS, PC A04/MF A01.

A novel crude distillation process, based on sequential flashing of the crude, conserves energy relative to conventional processing, requires smaller equipment, and has the requisite flexibility to handle a broad range of crudes. The sequential flash process shows energy savings relative to conventional processing of from 24% to 29%, assuming all energy in output streams and pumparounds above 200°F to be useful for preheat. An availability analysis indicates availability losses are 7 1/2 to 15% lower with the sequential flash process.

18387 **Coking of crude oil at high heat flux levels.** Scarborough, C.E.; Cherrington, D.C.; Diener, R.; Golan, L.P. (Exxon Res and Eng Co, Florham Park, NJ). *Chem. Eng. Prog.;* **75**: No. 7, 41-46(Jul 1979).

The application of fluidized bed combustion (FBC) to refinery, indirect-fired crude heaters is being investigated in a joint funded program by the U.S. Department of Energy and Exxon. The ultimate objective of this effort is to develop the technology necessary to burn low quality fuel such as coal or refinery by-product fuels in an economic and environmentally acceptable manner. One area of primary concern in this development is the rate of coke laydown on the inside tube wall of the crude carrying tubes. There-

fore, an experimental program to study the coking rate of a virgin crude oil has been undertaken. Details of the experimental study are given and experimental data are tabulated, plotted and evaluated. It is concluded that the coke laydown can be controlled by designing for all-liquid flow and a high mass velocity in the range of 2,250-3,000 kg/sec-m;sup 2;. The mass velocity is selected based on test data showing little or no coking at these high rates.

PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 18961

18388 Motor gasoline supplies and regulatory prices. Hearings before the Subcommittee on Energy and Power of the Committee on Interstate and Foreign Commerce, House of Representatives, Ninety-Fifth Congress, Second Session, December 21, 1978. Washington, DC; Committee on Interstate and Foreign Commerce (1979). 162p. GPO.

The Subcommittee on Energy and Power met on December 21, 1978 to conduct an oversignt hearing to consider current problems of the supply of gasoline, particularly unleaded gasoline. The Subcommittee was also concerned about the impact of recent and future gasoline price increases on inflation in general and on the nation's consumers in particular. The disparity between prices for leaded and unleaded gasolines was investigated. Statements were presented by representatives of the Society of Independent Gasoline Marketers of America; Gulf Oil Co.; National Oil Jobbers Council; Independent Gasoline Marketers Council; Nelson Oil Co.; DOE; Shell Oil Co.; EPA; Council on Wage and Price Stability; Chevron. Additional material submitted for the record is included in the publication. (MCW)

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 19729

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 18965

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 18350, 19312, 19563

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 18964

18389 Strategic petroleum reserve: reprogramming of funds. Hearing before the Subcommittee on Energy and Power of the Committee on Interstate and Foreign Commerce, House of Representatives, Ninety-Fifth Congress, Second Session, December 18, 1978. Washington, DC; Committee on Interstate and Foreign Commerce (1979). 256p. GPO.

The Subcommittee on Energy and Power met December 18, 1978 to investigate the cost overrun of the strategic petroleum reserve. More particularly, the subject is the candor of the DOE officials in Washington who run the strategic petroleum reserve program and how they deal with Congress and particularly with the subcommittee. In May 1977, the subcommittee was told that the total cost of putting 500 million barrels in storage would be $835 million. In May of 1978, Secretary Schlesinger also advised Congress that the DOE intended to double the size of the reserve. The committee also heard testimony on the correct information on the filling schedule. Many representatives from DOE presented statements and Ernest A. Fitzgerald from the Department of Defense presented a statement. Additional material was submitted for the record by DOE. (MCW)

TRANSPORT, PIPELINES, AND HANDLING

18390 (AD-A—068219) **Deepwater ports approach/exit control capabilities assessment. technology/service alternatives. Final report feb 78-feb 79.** Reinburg, L.R.; Rausch, A.R.; Pizzo, J.T.; Goddu, L.W.; Reardon, F.P. (PRC Systems Science Co., McLean, VA (USA)). Feb 1979. Contract DOT-CG-60351A. 162p. NTIS, PC A08/MF A01.

This report presents the results of a part of the Deepwater Ports Approach/Exit Control Capabilities Assessment Study. The report addresses existing or planned capabilities in such areas as traffic separation schemes, communication procedures; surveillance procedures; vessel control/advisory procedures; personnel manning qualifications and training. Pollution control measures and other areas capable of countering the hazards specified in the companion study, entitled Deepwater Ports Approach/Exit Hazard and Risk Assessment, were also included. Control capabilities are grouped into four major categories: ship control measures; pollution control measures; personnel considerations; and others. Various measures, whether existing, planned or potential alternatives, are discussed in detail with respect to system definition, system description, capability, accuracy where applicable, advantages, disadvantages, estimated cost where available, mitigative potential and pertinent references. A discussion on technology/service alternatives is presented in the final section. (Author)

PROPERTIES

18391 (PB—296146) **Physical properties and stability of water in fuel oil emulsions. Final report, August 1977—August 1978.** Fogler, H.S.; Reddy, S.R.; Storbeck, M.L.; Cross, J.B.; Siegmund, S.C. (Michigan Univ., Ann Arbor (USA). Dept. of Chemical Engineering). Mar 1979. Contract DOT-OS-70056. 121p. NTIS, PC A06/MF A01.

Energy conservation is a major national priority. One way to conserve is through the use of fuel extenders in our transportation systems and in home and industrial heating. Recently, it has been found that water-in-oil emulsions have a great potential to improve the burning characteristics of internal combustion engines and boiler burners by reducing the emission of pollutants and by providing a savings in the fuel supplied. The major objective of this research is to generate a data base for water-in-fuel oil emulsions. This report presents the first year interim results from a two year effort to determine the physical properties of water-in-fuel oil emulsions. Ultrasonically induced cavitation was used to produce emulsions in gasoline, No. 2 diesel oil, No. 4 heating oil, and No. 6 fuel oil without the use of surfactants. Density and viscosity measurements for each of the four fuels used are presented for various temperatures in the range from 20C to 90C. Interfacial tension measurements, against water for each of the four fuels used are presented for temperatures in the range from 30C to 79C. The stability of water-in-fuel oil emulsions has been studied. A scanning electron microscope and a spectrophotometer were used to study the aging of oil-in-water emulsions, while water-in-oil emulsions were studied using a creaming cell.

STORAGE

REFER ALSO TO CITATION(S) 19729

COMBUSTION

REFER ALSO TO CITATION(S) 18384, 19202, 19220

NATURAL GAS

GEOLOGY AND EXPLORATION

18392 (DOE/BC/10018—T6) **Remote characterization of fluid saturation in Western Sands. Annual report FY 1979.** Nuckols, E.B.; Jackson, J. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract AT19-79BC10018. 56p. Dep. NTIS, PC A04/MF A01.

Methods are to be developed for defining fluid saturation, porosity, and permeability in Western Gas Sands as found under in-situ reservoir conditions. The analyses will then be correlated with NMR studies and an improved downhole NMR tool will be developed. Accomplishments during FY 1979 in NMR include production of a homogeneous magnetic field, remote NMR detection, NMR sensitivity vs distance from axis, etc. 22 figures, 2 tables. (DLC)

18393 (MLM-MU—79-69-0011) **Physical and chemical characterization of Devonian gas shale. Quarterly status report, July 1-September 30, 1979.** Zielinski, R.E. (Mound Facility, Miamisburg, OH (USA)). 1979. Contract EY-76-C-04-0053. 92p. (MLM-EGSP-TPR-Q—011). Dep. NTIS, PC A05/MF A01.

This report primarily summarizes the physicochemical characterization results from wells PA-1 (McKean County, Pennsylva-

nia), PA-2 (Allegheny County, Pennsylvania), and OH-3 (Knox County, Ohio) as well as the well drilling operation for the OH-4 (Ashtabula County, Ohio) and PA-3 (Erie County, Pennsylvania) wells.

18394 (ORO—5194-T4) **Analysis of the structural parameters that influence gas production from the Devonian shale. Annual progress report, 1978-1979.** Negus-de Wys, J.N.; Dixon, J.M.; Evans, M.A.; Lee, K.D.; Rauch, H.W.; Ruotsala, J.E.; Wilson, T.H.; Williams, R.T. (West Virginia Univ., Morgantown (USA). Dept. of Geology and Geography). 1979. Contract EY-76-C-05-5194. 43p. Dep. NTIS, PC A03/MF A01.

This report is written to document progress made during the third year of our study for the Eastern Gas Shales (EGSP) Project, and it is organized to meet the needs of readers who have a variety of interests in the project. This first portion of Volume 1 includes the Executive Summary which gives a general overview highlighting the progress made over this contract year. The second portion of Volume 1 includes task reports written by the specific task investigators, and it is written primarily for scientists interested in a technical overview of the third year's work.

18395 (ORO—5203-12-T2) **Geologic and geochemical studies of the New Albany Group (Devonian black shale) in Illinois to evaluate its characteristics as a source of hydrocarbons. Quarterly progress report, July 1-September 30, 1979.** Bergstrom, R.E.; Shimp, N.F. (Illinois State Geological Survey, Urbana (USA)). 9 Oct 1979. Contract EY-76-C-05-5203. 49p. Dep. NTIS, PC A03/MF A01.

This project is a detailed analysis of the lithology, stratigraphy, and structure of the New Albany Group in Illinois to determine those characteristics of lithology, thickness, regional distribution, vertical and lateral variability, and deformation that are most relevant to the occurrence of hydrocarbons.

DRILLING, PRODUCTION, AND PROCESSING

18396 (DOE/ET/11399—1) **Reservoir characteristics in Uinta basin gas wells. Final report, September 1, 1978-January 31, 1980.** Boardman, C.R.; Knutson, C.F. (CK GeoEnergy Corp., Las Vegas, NV (USA)). 27 Nov 1979. Contract AC08-78ET11399. 97p. Dep. NTIS, PC A05/MF A01.

Volumes of 29 lenticular tight gas sandstone reservoirs in the Uinta Basin, Utah have been approximated from long-term pressure buildups on 6 wells. Average reservoir volume was interpreted to be about 240,000 ft^3 per ft of net pay. Outcrop reservoir geometry studies indicate an average reservoir volume (without any reservoir interconnection assumed) of about 30% less than the average based upon production analysis. Therefore, some reservoir interconnection may exist. Results of this study are consistent with the Knutson lenticular reservoir model in which average reservoir width is 22 times the gross sand thickness, length is 10 times the width, and reservoir interconnection is a function of the sand fraction in the productive interval. Apparent reservoir permeabilities, assuming radial flow, range from .009 to .052 millidarcies and actual sandstone matrix permeabilities are interpreted to range from .06 to .21 millidarcies. Fracture half lengths are interpreted to be about 0.1 ft/bbl of fluid with an average proppant load of 1.2 to 1.7 lb/gal at injection rates of 18 to 24 BPM and injection pressures of 2,500 to 4,600 psi for each 100 ft of gross sand in the fracced interval.

18397 (METC/CR—80/2) **Eastern Gas Shales Project outgassing analysis. Special report.** Streib, D.L. (Science Applications, Inc., Morgantown, WV (USA)). Feb 1980. Contract EW-78-C-21-8216. 108p. Dep. NTIS, PC A06/MF A01.

Two methods are used on the Eastern Gas Shales Project to measure the gas volume of encapsulated shale samples. The direct method measures pressure and volume and is initiated almost immediately upon encapsulation of the sample. A second method measures pressure, volume, and composition, and is initiated after pressure is allowed to build up over several weeks. A combination of the two methods has been used on selected samples, and yields more data as it allows extrapolation to account for gas lost prior to encapsulation. The stratigraphic horizons, characterized by dark shales with high organic and high carbon content and a relatively high gamma ray intensity of 200+ API units also have high gas contents (relative to other units within the same well). The Lower Huron, Rhinestreet, and Marcellus Shales are high in gas content relative to other stratigraphic units at the same sites. The difference in gas content of the same stratigraphic horizon between well sites appears to be controlled by the thermal maturity. Kinetic studies have shown that, in some samples, significant amounts of gas are released after the time when the gas volume would be initially measured. Additional work needs to be performed to determine why the rates and volume of gas released vary between samples.

18398 (ORO—5194-T3) **Analysis of the structural parameters that influence gas production from the Devonian shale. Annual progress report, 1978-1979.** Wys, J.N.; Dixon, J.M.; Evans, M.A.; Lee, K.D.; Shumaker, R.C.; Rauch, H.W.; Ruotsala, J.E.; Wilson, T.H.; Williams, R.T. (West Virginia Univ., Morgantown (USA). Dept. of Geology and Geography). 1979. Contract EY-76-C-05-5194. 610p. Dep. NTIS, PC A99/MF A01.

The following appendices are included: regional structure data, surface structure data, surface fracture data, production data, hydrology data, and geophysical data. (DLC)

18399 (ORO—5197-16) **Study of hydrocarbon: shale interaction. Progress report No. 16, October 1-December 31, 1979 and January 1-March 31, 1980.** Schettler, P.D. Jr.; Wampler, D.L. (Juniata Coll., Huntingdon, PA (USA)). 1980. Contract EY-76-S-05-5197. 87p. Dep. NTIS, PC A05/MF A01.

Data and interpretations relating the physical chemistry of Devonian shale to the productivity of natural gas wells are presented in this report. Specifically, methane isotherms, helium porosity, BET, and permeability and diffusion data are presented at pressures ranging up to 1000 psi. Use of the data in productivity calculations and resource estimation has been the subject of other reports in this series.

HEALTH AND SAFETY

18400 (UCID—18540) **Modeling of laminar flames in mixtures of vaporized liquefied natural gas (LNG) and air.** Westbrook, C.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Feb 1980. Contract W-7405-ENG-48. 12p. Dep. NTIS, PC A02/MF A01.

The combustion of fuel-air mixtures resulting from possible liquefied natural gas (LNG) spills is a central problem in the LLL Liquefied Gaseous Fuels Spill Effects Program. This combustion depends on a variety of factors, including the local fuel-air equivalence ratio, turbulence levels, humidity, characteristics of the ignition source, and many others. Numerical models dealing with the LNG vapor cloud generation and dispersion are being developed as part of this program, and these codes require chemical kinetics submodels to describe the fuel-air burning that might occur in a large LNG spill. Recent work on the development of these chemical kinetics submodels is described in this report.

ENVIRONMENTAL EFFECTS

REFER ALSO TO CITATION(S) 18350

18401 (DOE/BC/10003—3) **Western gas sands project status report, 1 December-31 December 1979.** (CER Corp., Las Vegas, NV (USA)). 1979. Contract AC08-79BC10003. 70p. Dep. NTIS, PC A04/MF A01.

This report summarizes December 1979, progress of the government-sponsored projects directed toward increasing gas production from the low-permeability gas sands of the western United States. The USGS continued work toward resource assessment in the four primary areas. Coring of the Rainbow Resources No. 1-3 Federal well, Sweetwater County, Wyoming, was initiated. Research continued at the National laboratories and Energy Technology Centers on improvement of enhanced gas recovery. Work on improved coring systems, logging studies, in situ permeability and rock/fluid interaction continued for Bartlesville Energy Technology Center. Los Alamos Scientific Laboratory continued in the nuclear magnetic resonance studies, and at Sandia Laboratories nuclear magnetic resonance testing continued on eleven cores. The Texstream diaphragm regulator has been installed at the Colorado Interstate Gas Company cyclic injection site. Twenty-three coreholes have been completed at the Sandia Hole No. 6 formation interface fracture experiment at the Nevada Test Site.

ARTIFICIAL STIMULATION, PLOWSHARE, ETC.

REFER ALSO TO CITATION(S) 18406

18402 (DOE/ET/12062—1) **Demonstration of massive hydraulic fracturing Piceance Basin, Rio Blanco County, Colorado.** Fitch, J.L.; Medlin, W.L.; Strubhar, M.K. (Mobil Research and Development Corp., Dallas, TX (USA)). Aug 1979. Contract EY-76-C-08-0678. 131p. Dep. NTIS, PC A07/MF A01.

Demonstration of massive fracturing to provide gas production from tight gas sands in the Piceance Basin was the objective of this jointly funded Mobil DOE project. This effort has been at least partially successful. The uppermost interval fractured, the Ohio Creek formation at 7324 to 7476 ft, appears to be commercially viable. The remaining sequence to total depth of 10,800 ft may also

be commercially attractive, depending on fractured well costs, gas prices and the risk of failure to achieve production capacity equal to, or greater than, that achieved in the present well. Prior work was performed by Mobil in the Brush Creek Unit, Mesa County, Colorado. One well, Brush Creek 1-25, was drilled to 10,330 ft and given two massive fracturing treatments before the well was plugged and abandoned as noncommercial. It was concluded that formation permeability was too low to justify additional work in the Brush Creek Unit. Piceance Creek well F31-13G was drilled to 10,800 ft. Nine zones were tested in the Mesaverde and Ohio Creek formations between 7324 to 10,680 ft. Six massive fracturing treatments were performed covering 7 of the 9 intervals. Average first-year flow potential of the well is estimated at 2.9 MMCF/day with 1.1 MMCF/day of this amount attributed to the uppermost zone.

18403 (UCRL—50036-79-3) **LLL Gas Stimulation Program. Quarterly progress report, July-September 1979.** Hanson, M.E.; Anderson, G.D.; Shaffer, R.J.; Towse, D.F.; Hearst, J.R.; Lin, W.; Cleary, M.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Nov 1979. Contract W-7405-ENG-48. 29p. Dep. NTIS, PC A03/MF A01.

The research and accomplishments of the LLL Gas Stimulation Program during the third quarter of FY 1979 are summarized. We have continued to analyze dynamic fracture propagation near interfaces and have begun some analyses to determine the effects of frictional slip along interfaces. Some experiments have been performed to analyze the effects of existing cracks near an interface. These experimental results compare with theoretical predictions. Analyses for the formulation of three-dimensional models have indicated some discretization schemes for development of the numerical models. We have continued the measurement of mechanical properties and failure characteristics of core material from the western tight gas reservoirs. Additionally, we have been applying various schemes, including the use of color plots, to evaluate the data obtained with continuous three-dimensional sonic logs.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 18964

18404 Natural gas supply and demand under the Natural Gas Policy Act of 1978. Erickson, E.W. Raleigh, NC; Natural Gas Supply Association (1979). 59p. (NP—24351). North Carolina State Univ., P.O Box 5368, Raleigh, NC.

The Natural Gas Policy Act (NGPA) must be evaluated in terms of both its long-run and short-run contributions to the US energy balance. Short-run perceptions have been affected by the initial transitory presence of a temporary surplus of gas deliverability and the basically unrelated experience with the administrative mechanics of the NGPA. In the longer run, there is the prospect of deregulation of the price of certain categories of new gas supplies after 1985. But there is a considerable span of years between now and 1985, and a real question is whether the NGPA will permit us to traverse this interval successfully. Alternative fuel prices are rising rapidly, drilling costs are going up faster than the NGPA inflation adjustment and real price escalation, and the NGPA ceiling prices may soon begin to be binding constraints on drilling activity. Whether or not the mechanics of the NGPA are working well is not the fundamental question. The real test of the functioning of the NGPA is in terms of its performance in facilitating the discovery and production of new gas supplies; and the magnitude of the longer-run problem of balancing supply and demand in the natural gas market is substantial. There has recently been considerable discussion of what is called a gas glut and a gas bubble. The presence of this temporary imbalance between supply and demand has raised questions with regard to (1) the adequacy or inadequacy of the economic incentives in the NGPA; (2) the uses of natural gas permitted by public policy; and (3) the longer-run ability of natural gas to help take up the shortfall between total energy demands and limited supplies of other fuel sources. The short-run phenomenon of the gas bubble and the intermediate-run problem of the possible trajectories of gas supplies between now and 1985 are examined.

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 18390

18405 (LIB-tr—4842) **New guide-lines for gas distribution.** Kottmann, A. Translated from *Gas- Wasserfach. Gas-Erdgas:* **119**: No. 6, 252-256(1978). 11p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The DVGW Codes of Practice, Standards, and Guidelines for natural gas distribution are summarized. The following subjects are discussed: distances between gas mains outside urban areas; gate valves in gas main networks; experienced and expert personnel; and pressure and tightness testing. (DC)

COMBUSTION

REFER ALSO TO CITATION(S) 18400

OIL SHALES AND TAR SANDS

SITE GEOLOGY

REFER ALSO TO CITATION(S) 18394, 18395, 18397, 18399

DRILLING, FRACTURING, AND MINING

18406 (FE—2346-52) **Influence of the weak bedding plane in Michigan antrim shale on laboratory hydraulic fracture orientation.** Kim, K.; Blaisdell, G.L. (Michigan Technological Univ., Houghton (USA). Dept. of Geology and Geological Engineering). Oct 1979. Contract EX-76-C-01-2346. 112p. Dep. NTIS, PC A06/MF A01.

The test results from both phases of the study showed that horizontal fractures were consistently created in samples with a confining (horizontal) stress in excess of 100 psi. Samples subjected to confining stresses less than 25 psi displayed only vertical fractures. Tests in the region between 25 and 100 psi showed either vertical or horizontal failures. Vertical fractures from both phases of testing showed a preferred fracture direction, suggesting a degree of anisotropy in the plane of bedding. Existing hydraulic fracturing theory was expanded for transversely isotropic rock to include the effect of two distinct tensile strengths. Experimental breakdown pressure trends were notably similar to those theoretically predicted for both vertical and horizontal failures. Miniature straddle packer operation was studied in unconfined plexiglass samples to observe the packer's sealing mechanics. Using a soft rubber (60 to 70 durometer) for the inflatable packer elements, it was found that the packer formed an O-ring type seal with the borehole wall. A low (300 psi) packer set-pressure was all that was necessary to insure that the packer formed a physical plug in the packer-borehole annulus. Borehole pressures of 5000 psi were held by the miniature straddle packer. Hydraulic fracturing tensile strengths in the plane of bedding were measured for cores from Dow/ERDA well 100 (Sanilac County, Michigan). The tensile strength was found to increase with depth for the upper 165 feet of the formation.

OIL PRODUCTION, RECOVERY, AND REFINING

IN SITU METHODS, TRUE AND MODIFIED

18407 Oil recovery from a Utah tar sand deposit by in situ combustion. Johnson, L.A.; Fahy, L.J.; Thornton, M.W.; Romanowski, L.J. Jr.; Marchant, L.C. (Laramie Energy Research Center, WY). *Interstate Oil Compact Comm. Com. Bull.;* **20**: No. 1, 63-75(Jun 1978).

The US tar sand resource consists of an estimated 30 billion barrels (4.7Gm^3) of oil. Most of this resource is in six large deposits in Utah. Through research and development to prove tar sand oil recovery methods, the Department of Energy is attempting to stimulate commercialization of this resource. Two in situ combustion field experiments have been conducted in Utah's Northwest Asphalt Ridge deposit. The second of these experiments, described in detail, was completed in early 1978 and consisted of a reverse combustion preparatory phase followed by a forward combustion production phase. Oil recovery exceeding 20% of the oil-in-place from a 40 ft by 120 ft (12m by 36m) nine-well line pattern provides encouragement for larger scale technical and economic demonstrations. This report includes the follwoing in detail: the design of the oil production process and its related air injection and production facilities; ignition of the process; conduct of the process (for 183 days); effluent monitoring; data acquisition (including use of an on-site minicomputer); data analysis; and resultant conclusions.

18408 (UCRL—83741) **Sweep efficiency modeling of modified in-situ retorts.** Gregg, M.L.; Campbell, J.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Mar 1980. Contract W-7405-ENG-48. 15p. (CONF-800425—1). Dep. NTIS, PC A02/MF A01.

From 13. oil shale symposium; Golden, CO, USA (16 Apr 1980).

A simple two-dimensional flow model is used to illustrate the effects of different porosity and permeability distributions and retort geometries on sweep efficiency during modified in-situ oil shale

retorting. Results of these case studies, two emphasizing different retort geometries and porosity distributions and one a study of nonuniform flow around a single, large block, are presented. The most interesting is a simulation of the flow field and resultant retort front movement for Occidental Petroleum Company Retort 5. A porosity/permeability distribution was chosen based on reported tracer data. The results of the model calculation indicate a sweep efficiency of about 55%. From these data an estimate can be made of the amount of oil degradation from burning, cracking, and coking. 17 figures.

SURFACE METHODS

18409 (PB—295665) **Technological overview reports for eight shale oil recovery processes.** Shih, C.C.; Cotter, J.E.; Prien, C.H.; Nevens, T.D. (TRW Environmental Engineering Div., Redondo Beach, CA (USA); Denver Research Inst., CO (USA)). Mar 1979. Contract EPA-68-02-1881. 115p. NTIS, PC A06/MF A01.

The purpose of the document is to supply background information for evaluation of environmental impacts and pollution control technologies in connection with oil shale development. Six surface retorting processes selected for characterization were: (1) Union Oil Retort B, (2) Paraho, (3) TOSCO II, (4) Lurgi Ruhrgas, (5) Superior Oil, and (6) USBM Gas Combustion. In addition, two in-situ retorting activities were selected: (1) the Occidental modified in-situ retort, and (2) the true in-situ development programs of Laramie Energy Technology Center (DOE). Each overview report contains information on oil shale processing. General process descriptions, shale preparation requirements, equipment types, operating conditions, process products and by-products, physical and chemical characteristics, energy and water requirements, process stream characteristics, processed shale disposal requirements, and site-specific environmental aspects are included.

18410 (UCID—18325) **Back-of-the-envelope method for predicting thermal-front velocities during oil-shale retorting.** Campbell, J.H.; Gregg, M.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Nov 1979. Contract W-7405-ENG-48. 28p. Dep. NTIS, PC A03/MF A01.

A one-dimensional model was developed for predicting motion of thermal fronts through an oil-shale rubble column. This model provides a simple method for planning new retort runs and for carrying out preliminary analyses of past experiments. The expressions used to describe front movement are simple algebraic equations that can be solved easily using a hand calculator. Typical values are listed for the required input quantities and give several examples of model usage. The model is not intended to replace existing more-sophisticated one-dimensional retorting codes. Instead, it should augment these modeling efforts by making better use of each computer-model run and by providing insight into the important chemical and physical processes involved in oil-shale retorting.

18411 (UCID—18595) **Oil shale project: large retort run summary, run L-3.** Ackerman, F.J.; Sandholtz, W.A.; Raley, J.H.; Carley, J.F.; Tripp, L.J.; Rothman, A.J.; Campbell, J.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1980. Contract W-7405-ENG-48. 78p. Dep. NTIS, PC A05/MF A01.

In the retort run L-3, a high yield (83 to 84% of FA) was achieved using a broad particle size distribution (-30.5 cm, + 0.001 cm) with 15 to 20% of the shale larger than 15 cm. The nonuniform flow in the retort was closely predicted by the changing shape of the steam front. Steam front measurements after the run indicated that the flow distribution through the bed was little affected by the retorting and combustion processes. The technique of ignition by hot-gas-preheating worked satisfactorily; no oxygen was observed in the exit gas during the entire retort operation. The temperature of the retort front was controlled by the air flux; no runaway temperatures were encountered when making the step grade change from 18 to 36 gal/ton. The hydrogen concentration in the exit gas reached approximately 18% in the rich (36 gal/ton) shale at the bottom of the bed; this is the highest concentration seen in any of the retorting experiments. A factor-of-three change in the CO/CO_2 ratio was observed as the combustion front moved from the 18 gal/ton to 36 gal/ton shale; also, about a factor-of-two change occurred in the rate of production of CH_4, H_2 and CO.

PROPERTIES AND COMPOSITION

REFER ALSO TO CITATION(S) 18393

18412 (ALO—0789-T19) **Properties of joints in Anvil Points oil shale.** Wilkening, W.W. (Terra Tek, Inc., Salt Lake City, UT (USA)). Apr 1978. Contract EY-76-C-04-0789. 66p. Dep. NTIS, PC A04/MF A01.

Properties of joints in two oil shales from Anvil Points, Colorado, containing 20 and 40 gal/ton of kerogen were determined by direct and triaxial shear. Twenty gal/ton oil shale was found to be about 2 to 5 times stiffer than 40 gal/ton oil shale, in terms of both normal and shear stiffness. The 20 gal/ton shale was also found to be stronger against sliding, by a factor of about 2, and the joint properties were found to be somewhat more reproducible for the lean shale than for the rich shale. The shear data was found to correlate well when the shear stress was normalized by the normal stress acting across the joint. The resulting shear stress/normal stress ratio vs shear displacement plots were essentially parabolic in form, with considerable nonlinearity, even at very low shear stress levels. The lean shale slid at a constant shear stress, while the rich shale continued to harden during sliding. A few direct shear tests were conducted at a strain rate two orders of magnitude higher than the rest, with no systematic variation in joint properties resulting. Also, the effect of staging, or retesting a joint which had been previously sheared at a different normal stress level, was found to be negligible.

18413 (FE—2346-54) **Dynamic Young's Moduli, Poisson's Ratios and Damping Ratios of Antrim Oil Shale.** Somogyi, F. (Wayne State Univ., Detroit, MI (USA)). Jan 1980. Contract EX-76-C-01-2346. 18p. Dep. NTIS, PC A02/MF A01.

Dynamic Young's Modulus, Poisson's Ratio and Damping Ratio in the horizontal and vertical directions have been measured on approximately 30 samples recovered from Well No. 201 and three samples from Well No. 107. Young's Moduli and Damping Ratios were determined by means of a longitudinal resonant frequency technique. Impact of strain gaged specimens was utilized for measurement of Poisson's Ratios. Longitudinal resonant frequency in the direction perpendicular to the bedding planes (i.e., vertical) is extremely sensitive to discontinuities in the test specimen. For samples from Well No. 201, vertical Young's Modulus varied from 2.5 to 26 GN/m^2; Damping Ratio from approximately 1 to 4%; and Poisson's Ratio, in general, from 0.2 to 0.3. In the horizontal direction, Young's Modulus tends to increase with depth, generally ranging in value from 28 to 42 GN/m^2; Damping Ratio varies randomly from 1 to 3%, and Poisson's Ratio remains approximately constant at 0.3.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 19714

ENVIROMENTAL ASPECTS

REFER ALSO TO CITATION(S) 18350, 18409, 19340, 19341

18414 (PNL-SA—7473) **Influence of irrigation and weathering reactions on the composition of percolates from retorted oil shale in field lysimeters.** Garland, T.R.; Wildung, R.E.; Harbert, H.P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1979. Contract EY-76-C-06-1830. 8p. (CONF-790440—6). Dep. NTIS, PC A02/MF A01.

From 12. oil shale symposium; Golden, CO, USA (18 Apr 1979).

Major cations, anions, trace elements and dissolved organic C were measured in percolate from retorted oil shale collected from irrigated lysimeters in the field at Anvil Points, Colorado, over a two year period. The investigations indicated that chemical equilibrium was not established over the monitoring period and major changes occurred in percolate composition as a function of applied water volume and water residence time in the shale. Field and laboratory studies indicated that several factors contributed to changes in the chemistry of the shale on weathering, including recarbonization of the surface horizons with atmospheric CO_2 and the activities of microorganisms in surface and subsurface horizons. However, the principal mechanism responsible for the decreases in pH and salt concentrations appeared to be the conversion of major quantities of sulfide in the retorted shale to sulfate through a thiosulfate intermediate.

NUCLEAR FUELS

RESERVES

18415 (PNL—3150) **Economics of large-scale thorium oxide production: assessment of domestic resources.** Young, J.K.; Bloomster, C.H.; Enderlin, W.I.; Morgenstern, M.H.; Ballinger, M.Y.; Drost, M.K.; Weakley, S.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1980. Contract EY-76-C-06-1830. 358p. Dep. NTIS, PC A16/MF A01.

The supply curve illustrates that sufficient amounts of thorium exist supply a domestic thorium-reactor economy. Most likely

costs of production range from $3 to $60/lb ThO_2. Near-term thorium oxide resources include the stockpiles in Ohio, Maryland, and Tennessee and the thorite deposits at Hall Mountain, Idaho. Costs are under $10/lb thorium oxide. Longer term economic deposits include Wet Mountain, Colorado; Lemhi Pass, Idaho; and Palmer, Michigan. Most likely costs are under $20/lb thorium oxide. Long-term deposits include Bald Mountain, Wyoming; Bear Lodge, Wyoming; and Conway, New Hampshire. Costs approximately equal or exceed $50/lb thorium oxide.

EXPLORATION

18416 (CONF-7804163—(Vol.2), pp 835-844) **Simultaneous use of geological, geophysical, and LANDSAT digital data in uranium exploration.** Prelat, A.E. (Stanford Univ., CA); Lyon, R.J.P.; Missallati, A. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

In an 850 sq km area of uranium-bearing crystalline rocks, in southern Libya, which had been mapped geologically in 1974, and over which concurrent low-altitude gamma-ray spectrometry (total count) and magnetics were also flown, a fourteen man-month pilot study was made using multivariate statistical methods based on merged datasets from quantified geological, geophysical, and LANDSAT data. Thirty-one parameters were measured from the 1:50,000 scale geological maps, and two geophysical parameters obtained by re-sampling the contoured geophysical maps. Appreciating that LANDSAT data are also quantified geophysical matrices, the four channels and six ratios were extracted from the computer compatible tapes, making a total of ten LANDSAT variables. A grid with cells 500 m x 450 m in size was superimposed over the study area. The grid oriented according to the LANDSAT azimuth contained 3364 geographic cells. The 43 variables were measured in each cell and then the statistical technique known as discriminant function analysis was used to predict exploration targets. Transformations of the variables, to approximate the normal distribution were necessary to effectively applied discriminant function analysis. The discriminant analysis procedure was used to calculate a discriminant linear function between the cells with aeroradiometric values above 1200 counts/second and cells with values below that level. The functions obtained proved to be statistically-and-geologically reliable and can be used to identify cells from other areas with the same geological setting by using only the geological and LANDSAT variables shown to have discriminating power in separating the two groups.

18417 (GJBX—48(80)) **Engineering report on the Brushy Basin drilling project, Cedar Mountain, Emery County, Utah.** Kiloh, K.D. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Mar 1980. Contract EY-76-C-13-1664. 33p. Dep. NTIS, PC A03/MF A01.

The Brushy Basin drilling project was conducted by Bendix Field Engineering Corporation (BFEC) in support of the United States Department of Energy (DOE) National Uranium Resource Evaluation (NURE) program. This project consisted of 12 drill holes (table 1), ranging in depth from 101 feet (30.78 m) to 920 feet (280.39 m). A total of 6,867.5 feet (2,093.17 m) was drilled by rotary methods. Purpose was to obtain subsurface data for estimating the intermediate-grade (0.01 percent to 0.05 percent U_3O_8) uranium resources of the Brushy Basin Member of the Morrison Formation (Jurassic) in the Cedar Mountain area of the San Rafael swell, Emery County, Utah. Drilling began on June 16, 1979, and was completed on July 29, 1979, with final site restoration.

18418 (GJBX—52(80)) **Aerial radiometric and magnetic survey: Caliente National Topographic Map, Nevada/Utah.** (Geodata International, Inc., Dallas, TX (USA)). 1980. Contract EY-76-C-13-1664. 254p. Dep. NTIS, PC $30.50/MF $18.95.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Caliente National Topographic Map NJ11-9 are presented. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium, and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

18419 (GJBX—57(80)) **Aerial radiometric and magnetic survey: Rocky Mount/Manteo Topographic Map, North Carolina.** (Geodata International, Inc., Dallas, TX (USA)). 1980. Contract EY-76-C-13-1664. 300p. Dep. NTIS, PC $25.50/MF $13.55.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Rocky Mount/Manteo National Topographic Map NI18-1 are presented. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium, and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, indluding descriptions of the various geologic units and the corresponding airborne data, is included also.

18420 (GJBX—59(80)(Vol.2)) **Aerial radiometric and magnetic reconnaissance survey of south-central Colorado Trinidad Quadrangle.** (Texas Instruments, Inc., Dallas (USA)). Jan 1980. Contract EY-76-C-13-1664. 592p. Dep. NTIS, PC $30.50/MF $6.20.

The results of a high-sensitivity, aerial, gamma-ray spectrometer and magnetometer survey of the Trinidad Quadrangle, Colorado, are presented. Instrumentation and methods are described in Volume 1 of this final report. Statistical and geological analysis of radiometric data revealed 51 uranium anomalies worthy of field-checking as possible prospects.

18421 (GJBX—62(80)) **Aerial radiometric and magnetic survey: Lander National Topographic Map, Wyoming.** (Geodata International, Inc., Dallas, TX (USA)). 1979. Contract EY-76-C-13-1664. 346p. Dep. NTIS, PC $36.50/MF $19.85.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Lander National Topographic Map NK12-6 are presented. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

18422 (GJBX—63(80)) **Aerial radiometric and magnetic survey: Arminto National Topographic Map, Wyoming.** (Geodata International, Inc., Dallas, TX (USA)). 1979. Contract EY-76-C-13-1664. 304p. Dep. NTIS, PC $30.35/MF $15.80.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Arminto National Topographic Map NK13-1 are presented. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

18423 (GJBX—64(80)) **Aerial radiometric and magnetic survey: Thermopolis National Topographic Map, Wyoming.** (Geodata International, Inc., Dallas, TX (USA)). 1979. Contract EY-76-C-13-1664. 342p. Dep. NTIS, PC $36.50/MF $19.55.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Thermopolis National Topographic Map NK12-3 are presented. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data which each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnet-

ic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

18424 (GJBX—65(80)) **Aerial radiometric and magnetic survey: Aztec National Topographic Map, New Mexico.** (Geodata International, Inc., Dallas, TX (USA)). 1979. Contract EY-76-C-13-1664. 404p. Dep. NTIS, PC $39.50/MF $21.35.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Aztec National Topographic Map NJ13-10 are presented. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

18425 (GJBX—66(80)) **Hydrogeochemical and stream sediment detailed geochemical survey for Wichita Uplift Region, Oklahoma.** Butz, T.R.; Switek, J.; Rutledge, D.A.; Bard, C.S.; Helgerson, R.N.; Grimes, J.G. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 29 Feb 1980. Contract W-7405-ENG-26. 287p. (K/UR—31). Dep. NTIS, PC $16.50/MF $3.50.

Results of the Wichita Uplift detailed geochemical survey are reported. Field and laboratory data are reported for 540 groundwater and 425 stream sediment samples. Radiometric analyses for uranium, thorium, and potassium are reported for 135 rock samples. Statistical and areal distributions of uranium and possible uranium-related variables are provided. A generalized geologic map of the survey area is provided and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are briefly discussed. For groundwater samples, evidence provided by a weighted sums analysis of uranium, arsenic, and molybdenum and by areal distribution of selenium indicates three areas with potential for uranium mineralization. One area is located along the Jackson-Tillman county line just north of the Red River and another area is located to the north in east central Jackson County. Favorability is indicated by high values for uranium, arsenic, and molybdenum and nearby wells with high selenium values. Another promising area occurs in Kiowa and Greer Counties. Groundwater with high values for the uranium weighted sums model and selenium in this area have high values for salinity indicators, suggesting that the groundwaters are influenced by brines from local oil fields. The stream sediment data indicate that the most promising area for potential uranium mineralization is the southern Wichita Mountains area. The deposits consist of heavy and residual mineral placers. High concentrations of uranium-bearing minerals in stream sediments in this region may indicate vein-type or pegmatite deposits in granites in the southern Wichita Mountains, and suggest that the Wichita Uplift area may act as a good source environment for uranium.

18426 (GJBX—67(80)) **Hydrogeochemical and stream sediment reconnaissance basic data for Beaumont NTMS Quadrangle, Texas.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 29 Feb 1980. Contract EY-76-C-13-1664. 266p. (K/UR—134). Dep. NTIS, PC $14.50/MF $3.50.

Results of a reconnaissance geochemical survey of the Beaumont Quadrangle, Texas are reported. Statistical data and areal distributions for uranium and uranium-related variables are presented for 707 groundwater and 619 stream sediment samples. Also included is a discussion on geologic factors considered significant in evaluating the potential for uranium mineralization. Groundwater data indicate that uranium concentrations above the 85th percentile occur primarily in a trend through the west central section of the quadrangle. Waters in this area are produced feom the Jasper aquifer, units that are defined as being part of the Burkeville confining system, and the Evangeline aquifer and have high values for arsenic, calcium, magnesium, and strontium. A smaller trend of high uranium values is located in the south central section of the quadrangle where waters are mainly produced from the Chicot aquifer. Stream sediment data indicate that uranium concentrations above the 85th percentile occur in sediments from the northern third and southeastern section of the quadrangle. In the northern trend of high uranium values, the sediments are derived from the Jackson Group and the Fleming and Catahoula Formations. Uranium appears to be associated with resistate and/or heavy minerals. Sediments that compose the southeastern trend are derived from the Beaumont Formation.

18427 (K/UR—36) **Applications of inductively coupled plasma spectroscopy to geochemical reconnaissance for uranium exploration.** Cagle, G.W.; Butz, T.R. (Oak Ridge National Lab., TN (USA)). Jan 1980. Contract W-7405-ENG-26. 43p. (CONF-800110—2). Dep. NTIS, PC A03/MF A01.

From International conference on developments in atomic plasma spectrochemical analyses; San Juan, Puerto Rico (7 Jan 1980).

The analysis of large numbers of natural groundwater and stream sediment samples by Inductively Coupled Plasma (ICP) Spectroscopy has been applied to a geochemical reconnaissance program as part of the National Uranium Resource Evaluation Program. Approximately 25 elements have been determined in over 60,000 samples by ICP analysis. These data are combined with additional measurements obtained by atomic absorption, colorimetry, neutron activation, and fluorescence spectroscopy. Results are presented and interpreted in terms of the uranium favorability of areas in Texas where this survey has been completed.

18428 (K/UR—37) **Hydrogeochemical and stream sediment reconnaissance basic data reports computer program requests manual.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 31 Jan 1980. Contract W-7405-ENG-26. 116p. Dep. NTIS, PC A06/MF A01.

This Hydrogeochemical and Stream Sediment Reconnaissance Basic Data Reports Computer Program Request Manual is intended to aid those who are unfamiliar with ordering computer output for verification and preparation of Uranium Resource Evaluation (URE) Project reconnaissance basic data reports. The manual is also intended to help standardize the procedures for preparing the reports. Each section describes a program or group of related programs. The sections are divided into three parts: Purpose, Request Forms, and Requested Information. Under Requested Information, the letters refer to the area where the letter appears circled on the forms in the section.

18429 (ORO—5602-T1(Vol.2)) **Acquisition, classification, and evaluation of engineering and geologic information and characteristics of West Virginia petroleum reservoirs amenable to enhanced oil recovery technology, particularly carbon dioxide injection. Final technical report. Volume II: appendices.** Pease, R.W. (Gruy Federal, Inc., Houston, TX (USA)). May 1979. Contract ET-78-C-05-5602. 145p. Dep. NTIS, PC A07/MF A01.

This document comprises two appendices: field data for assessing the potential of the CO_2 displacement process in West Virginia reservoirs, and oil analyses for 27 West Virginia fields. (DLC)

18430 (LA-tr—79-45) **Fission neutron logging with threshold detectors.** Kartashov, M.P.; Davydov, Yu.B. 1979. Translated from Yaderno-geofizicheskie issledovaniya, Ural, USSR, 1975, pp 25-28. 7p. Dep. NTIS, PC A02/MF A01.

The following conclusions can be drawn. The distribution of the fast fission neutron flux in an infinite, uniform, uranium containing medium was investigated, with the effect of moisture and salinization of the ground water taken into account. Estimates of the fission neutron counting rate with threshold detectors with a coating of uranium-234 or neptunium-237 were calculated. The possibility of the use of fast fission neutrons and threshold detectors for the identification of uranium in boreholes was demonstrated. Specific recommendations on increasing the fission neutron yield were obtained. The advisability of the use of small probes and preliminary moderation of the source neutrons was noted.

MINING

18431 (PB—296336) **In-situ leaching studies of uranium ores, phase iv. Open file report (final).** Grant, D.C. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Nov 1978. Contract H0262004. 501p. NTIS, PC A22/MF A01.

In situ uranium mining is a process for recovering uranium from relatively low-grade ore bodies. A laboratory technique for simulating this underground leaching process was developed and used to determine the effects of leaching variables on the permeability, uranium recovery, and ore-aquifer leakage for ores from Texas and Wyoming. Agitation leach tests were used to examine the effect of pressure, pH, and leach concentration. Column tests were performed to study the effect of various leachants and oxidants: sulfuric acid, ammonium, sodium and potassium bicarbonates, peroxide, and dissolved oxygen. High pressure leaching and recycling of the leach solution were also examined. Permeability was studied as a function of both pressure and solution. To deal with post-leach restoration, potential chemical leakage was examined. Also, mineralogical characteristics of the virgin and processed ores were identified to determine the effect of ore processing. Post-leach ore residues were examined to determine the effect of an acid and an alkaline leach on the ore minerals.

ENRICHMENT

REFER ALSO TO CITATION(S) 18486

CENTRIFUGATION

18432 (LA—8258-MS) **Novel approach to the computation of axisymmetric countercurrent patterns in gas centrifuges.** Cloutman, L.D. (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7405-ENG-36. 36p. Dep. NTIS, PC A03/MF A01.

We present a numerical algorithm based on finite Fourier-Chebyshev transforms for solving the total reflux, thermal-drive centrifuge problem. The method should be capable of providing steady-state solutions with excellent resolution in a few minutes of computer time. The same technique may be easily applied to other problems, including the isotope diffusion equation. A simple diffusion equation is solved to show certain aspects of the numerical method, in particular, its excellent convergence properties.

DEPLETED URANIUM

REFER ALSO TO CITATION(S) 19208

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 18443, 18481, 18873

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 18445, 18484, 18485, 19159, 19172

18433 **Analysis of the transient and steady-state operation of a countercurrent liquid--liquid solvent extraction process.** Groenier, W.S.; Rainey, R.H.; Watson, S.B. (Oak Ridge Natl Lab, Tenn). *Ind. Eng. Chem., Process Des. Dev.;* **18**: No. 3, 385-394(Jul 1979).

The computer program SEPHIS has been developed to aid in determining optimum solvent extraction conditions for the reprocessing of nuclear power reactor fuels by the Purex method. The possible applications to inventory control for nuclear material safeguards, nuclear criticality analysis, and process analysis and control are of special interest. The method is also applicable to other countercurrent liquid-liquid solvent extraction processes that are characterized by rapid chemical kinetics, that may involve multiple solutes, and that are performed in conventional contacting equipment.

18434 **Gas-liquid interfacial area of a sieve-plate with downcomers and 0.6% perforation.** Luks, K.D.; Kohn, J.P.; Banchero, J.T. (Univ of Notre Dame, Indiana). *Ind. Eng. Chem., Process Des. Dev.;* **18**: No. 3, 562-565(Jul 1979).

Measurements were made of gas-liquid interfacial area in the froth above a sieve tray with an unusually low proportion of perforated area, only 0.6%. The measurements were made by the Danckwerts chemical absorption method using the CO;sub 2;-NaOH system. Areas ranged from 259 to 286 m;sup 2;/m;sup 3; of froth for superficial gas velocities of 0.036 to 0.060 m/s. These results appear consistent with those reported for sieve trays with larger proportions of perforated area.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 18449

18435 (DOE/NE—0002) **Spent fuel storage requirements: the need for away-from-reactor storage.** (Department of Energy, Washington, DC (USA). Div. of Spent Fuel Storage and Transfer). Jan 1980. 12p. Dep. NTIS, PC A02/MF A01.

The analyses of on-site storage capabilities of domestic utilities and estimates of timing and magnitude of away-from-reactor (AFR) storage requirements were presented in the report DOE/ET-0075 entitled Spent Fuel Storage Requirements: The Need For Away-From-Reactor Storage published in February 1979 by the US Department of Energy. Since utility plans and requirements continue to change with time, a need exists to update the AFR requirements estimates as appropriate. This short report updates the results presented in DOE/ET-0075 to reflect recent data on reactor operations and spent fuel storage. In addition to the updates of cases representing the range of AFR requirements in DOE/ET-0075, new cases of interest reflecting utility and regulatory trends are presented.

WASTE MANAGEMENT

18436 (DOE/NV/00410—54) **Area 5 Radioactive Waste Management Site Safety Assessment Document.** Horton, K.K.; Kendall, E.W.; Brown, J.J. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)). Feb 1980. Contract AC08-76NV00410. 75p. Dep. NTIS, PC A04/MF A01.

The Area 5 Radioactive Waste Management Safety Assessment Document evaluates site characteristics, facilities and operating practices which contribute to the safe handling and storage/disposal of radioactive wastes at the Nevada Test Site. Physical geography, cultural factors, climate and meteorology, geology, hydrology (with emphasis on radionuclide migration), ecology, natural phenomena, and natural resources are discussed and determined to be suitable for effective containment of radionuclides. Also considered, as a separate section, are facilities and operating practices such as monitoring; storage/disposal criteria; site maintenance, equipment, and support; transportation and waste handling; and others which are adequate for the safe handling and storage/disposal of radioactive wastes. In conclusion, the Area 5 Radioactive Waste Management Site is suitable for radioactive waste handling and storage/disposal for a maximum of twenty more years at the present rate of utilization.

18437 (ORNL/TM—7253) **High-level waste program. Progress report, October 1, 1979-December 31, 1979.** (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 51p. Dep. NTIS, PC A04/MF A01.

Waste Management Analysis for Nuclear Fuel Cycles: Example scenarios were evaluated for low-level waste management analysis. Depletion calculations for early- and advanced-oxide U-Pu cycle LMFBRs were completed. Fixation of Waste in Concrete: FUETAP concretes were made that had compressive strengths >60 MPa, thermal conductivities >1 W/m.K and densities of ~ 2 g/cm^3. These solids were able to withstand temperatures of 900°C for 24 h. Study of Ceramic and Cermet Waste Forms: Construction of the 23-cm ID spray calciner to be used for urea-waste solutions is nearing completion. Development of densification techniques at both low and elevated temperatures is continuing. Alternative High-Level Waste Forms Development: Sol-gel Synroc spheres (1 wt % waste) as dense as 95% with 1% open porosity have been prepared by sintering at 1200°C. Initial tests to incorporate as much as 25 wt % of simulated SRP waste sludge in Synroc spheres were successful. Construction has begun on a sphere forming system. High-Level Waste Container Development: A fabrication, assembly, and inspection sequence has been developed for a canister and overpack.

18438 (RHO-CD—568) **Radioactive waste package acceptance criteria.** Moore, E.L.; Calmus, D.B. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 1978. Contract EY-77-C-06-1030. 66p. Dep. NTIS, PC A04/MF A01.

Preliminary acceptance criteria have been developed for packages containing nuclear waste which must be stored or disposed of by the US Department of Energy. Acceptance criteria are necessary to ensure that the waste packages are compatible with all elements of the Waste Management System. The acceptance criteria are subject to revision since many of the constraints that will be imposed on the waste packages by the Waste Management System have either not been defined or are being revised. Delineation of the acceptance criteria will provide bases for handling, transporting and disposing of the commercial waste.

18439 (UCID—18150) **Regulatable elements in the high-level waste management program.** Oakley, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Dec 1979. Contract W-7405-ENG-48. 32p. Dep. NTIS, PC A03/MF A01.

Regulatable elements of a deep geological nuclear waste isolation system are those characteristics of a candidate system which need to be specified to achieve control of its performance. This report identifies the regulatable elements with respect to waste form, repository design, site suitability, and the modeling and decision analysis processes. Regulatable elements in each section are listed and described briefly as they affect the short-term and long-term performance of a deep geological repository.

WASTE PROCESSING

18440 (DOE/ET/41900—T1) **Development of tailored ceramics for geologic storage of nuclear wastes. Quarterly progress report, October 1, 1979-December 31, 1979.** (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 15 Feb 1980. Contract AC09-79ET41900. 25p. Dep. NTIS, PC A02/MF A01.

Tailored ceramics are crystalline assemblages made by high-temperature and pressure consolidation of a nuclear waste with selected additives. The multitask program includes waste form development and characterizations, and process and equipment development. (DLC)

18441 (DP-MS—79-94) **High-level defense waste solidification at the Savannah River Plant.** Rhoad, H.D. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract EY-76-C-09-0001. 13p. (CONF-800303—11). Dep. NTIS, PC A02/MF A01.

From 179. national meeting of the American Chemical Society; Houston, TX, USA (23 Mar 1980).

Radioactive waste management at the Savannah River Plant is described. Their process for solidifying liquid wastes is discussed. Leaching studies of glass were performed and the results are discussed. (DC)

18442 (EGG-WM—5103) **TRU waste processing comparison: slagging pyrolysis versus modified glassmaker.** Bonner, W.F.; Cox, N.D.; Hootman, H.E.; Nelson, D.C.; Pye, D. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1980. Contract EY-76-C-07-1570. 114p. Dep. NTIS, PC A06/MF A01.

A task force was assembled to make a technical comparison of the expected performance of two processing systems potentially applicable for treating TRU waste at the Idaho National Engineering Laboratory. One system contained a slagging pyrolysis incinerator; the other a modified Penberthy Electromelt glassmaker. Although the glassmaker technology is essentially undeveloped, it was assumed that the glassmaker could eventually be modified to operate as a combined waste incinerator and melter; that is, to perform the same functions as a slagger. Using a decision analysis methodology to evaluate figures-of-merit, the task force found no significant difference in the performance of the two systems. Some areas for future R and D efforts are recommended for both types of incinerators.

18443 (LA-UR—80-835) **Plutonium scrap processing at the Los Alamos Scientific Laboratory.** Nixon, A.E.; McKerley, B.J.; Christensen, E.L. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 24p. (CONF-800303—12). Dep. NTIS, PC A02/MF A01.

From 179. national meeting of the American Chemical Society; Houston, TX, USA (23 Mar 1980).

The Los Alamos Scientific Laboratory currently has the newest plutonium handling facility in the nation. Los Alamos has been active in the processing of plutonium almost since the discovery of this man-made element in 1941. One of the functions of the new facility is the processing of plutonium scrap generated at LASL and other sites. The feed for the scrap processing program is extremely varied, and a wide variety of contaminants are often encountered. Depending upon the scrap matrix and contaminants present, the majority of material receives a nitric acid/hydrofluoric acid or nitric acid/calcium fluoride leach. The plutonium nitrate solutions are then loaded onto an anion exchange column charged with DOWEX 1 x 4, 50 to 100 mesh, nitrate form resin. The column is eluted with 0.48 M hydroxyl amine nitrate. The $Pu(NO_3)_3$ is then precipitated as plutonium III oxalate which is calcined at 450 to 500°C to yield a purified PuO_2 product.

18444 (MLM—2697) **Pelletized waste form demonstration program: final design criteria for waste pelletization.** Lewis, E.L. (Mound Facility, Miamisburg, OH (USA)). 28 Mar 1980. Contract AC04-76DP00053. 9p. Dep. NTIS, PC A02/MF A01.

A cement fixation process was developed for immobilizing incinerator ash with a radionuclide concentration ~ 200 nCi/g ash. The design criteria include process descriptions for sizing, calcination, blending, pelletization, and packaging-storage operations and performance data for the sizing equipment, calciner, blending apparatus, and press.

18445 (PNL-SA—7499) **Comparison of bitumen and cement immobilization of intermediate- and low-level radioactive waste.** Voss, J.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract EY-76-C-06-1830. 26p. (CONF-790204—12). Dep. NTIS, PC A03/MF A01.

From Symposium on waste management and fuel cycles 1979; Tucson, AZ, USA (28 Feb 1979).

This paper discusses a systems comparison of two available immobilization processes for intermediate- and low-level radioactive wastes -- bitumen and cement. This study examines a conceptual coprocessed UO_2 - PuO_2 fuel cycle. Radioactive wastes are generated at each stage of this fuel cycle. This study focuses on these transuranic (TRU) wastes generated at a conceptual Fuel Coprocessing Facility. In this report, these wastes are quantified, the immobilization systems conceptualized to process these wastes are presented, and a comparison of the systems is made.

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 18383, 18435, 18436, 18478, 19155, 19196, 19199, 19200, 19723, 19724

18446 (CONF-800334—3) **Advanced biological treatment of aqueous effluent from the nuclear fuel cycle.** Pitt, W.W. Jr.; Hancher, C.W.; Patton, B.D.; Shumate, S.E. II. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 15p. Dep. NTIS, PC A02/MF A01.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

Many of the processing steps in the nuclear fuel cycle generate aqueous effluent streams bearing contaminants that can, because of their chemical or radiological properties, pose an environmental hazard. Concentration of such contaminants must be reduced to acceptable levels before the streams can be discharged to the environment. Two classes of contaminants, nitrates and heavy metals, are addressed in this study. Specific techniques aimed at the removal of nitrates and radioactive heavy metals by biological processes are being developed, tested, and demonstrated. Although cost comparisons between biological processes and current treatment methods will be presented, these comparisons may be misleading because biological processes yield environmentally better end results which are difficult to price. The fluidized-bed biological denitrification process is an environmentally acceptable and economically sound method for the disposal of nonreusable sources of nitrate effluents. A very high denitrification rate can be obtained in a FBR as the result of a high concentration of denitrification bacteria in the bioreactor and the stagewise operation resulting from plug flow in the reactor. The overall denitrification rate in an FBR ranges from 20- to 100-fold greater than that observed for an STR bioreactor. It has been shown that the system can be operated using Ca^{2+}, Na^{+}, or NH_4^{+} cations at nitrate concentrations up to 1 g/liter without inhibition. Biological sorption of uranium and other radionuclides (particularly the actinides) from dilute aqueous waste streams shows considerable promise as a means of recovering these valuable resources and reducing the environmental impact, however, further development efforts are required.

18447 (LA—8210-PR) **Laboratory studies of radionuclide distributions between selected groundwaters and geologic media. Progress report, October 1-December 31, 1979.** Erdal, B.R. (comp.). (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 49p. Dep. NTIS, PC A03/MF A01.

This report presents the Los Alamos Scientific Laboratory contribution to the Waste/Rock Interactions Technology program. The majority of the effort involved extensive studies under reduced oxygen and carbon dioxide conditions, measurements of isotherms, microautoradiographic studies, and migration rate studies. Efforts to estimate uranium, plutonium, and neptunium solubilities were initiated.

18448 (LA—8224-PR) **Studies of transuranic waste storage under conditions expected in the Waste Isolation Pilot Plant (WIPP). Progress report, October 1-December 31, 1979.** Kosiewicz, S.T.; Zerwekh, A. (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 8p. Dep. NTIS, PC A02/MF A01.

This is the ninth quarterly report describing progress in an experimental program to determine the effects of radiolytic, thermal, and catalyzed thermal degradation of various forms of existing or developmental transuranic wastes proposed for Waste Isolation Pilot Plant emplacement. We conclude that there is no dose rate dependency for the radiolysis of cellulosics. Data from desiccation experiments indicate that 8% of the contained water in process sludge is mildly bound.

18449 (ORNL—5607) **Review of information on the radiation chemistry of materials around waste canisters in salt and assessment of the need for additional experimental information.** Jenks, G.H.; Baes, C.F. Jr. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 80p. Dep. NTIS, PC A05/MF A01.

The brines, vapors, and salts precipitated from the brines will be exposed to gamma rays and to elevated temperatures in the regions close to a waste package in the salt. Accordingly, they will be subject to changes in composition brought about by reactions induced by the radiations and heat. This report reviews the status of information on the radiation chemistry of brines, gases, and solids which might be present around a waste package in salt and to assess the need for additional laboratory investigations on the radiation chemistry of these materials. The basic aspects of the radiation chemistry of water and aqueous solutions, including concentrated salt solutions, were reviewed briefly and found to be substantially unchanged from those presented in Jenks's 1972 review of radiolysis and hydrolysis in salt-mine brines. Some additional information pertaining to the radiolytic yields and reactions in brine solutions has become available since the previous review, and this information will be useful in the eventual, complete elucidation of the radiation chemistry of the salt-mine brines. 53 references.

18450 (ORNL/TM—7106) **Cement technology for borehole plugging: interim report on the effects of fly ash and salt on the physical properties of cementitious solids.** Moore, J.G.; Morgan, M.T.; McDaniel, E.W.; Greene, H.B.; West, W.A. (Oak Ridge

National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 31p. Dep. NTIS, PC A03/MF A01.

Results of initial studies of a systematic investigation to determine the effects of fly ash and salt on the physical properties of pozzolanic concretes and saltcretes are reported. Addition of fly ash to mortars decreased the set time and bleed characteristics and increased the compressive strength and permeability, but it had very little effect on the density or the thermal conductivity of the solid. The magnitude of these effects was only slightly related to the lime content of the fly ash. In the case of saltcretes, low-lime fly ash slightly decreased the set time and the bleed characteristics of the wet mix. However, a high-lime fly ash doubled the set time and decreased the bleed characteristics to essentially zero. The compressive strength of saltcretes was increased by the addition of fly ash and was independent of the lime content. Such additions had little effect on the thermal conductivity or density. The thermal conductivities of cement pastes containing fly ash showed a near-linear relationship with the density of the resulting solids. In the case of mortars, the thermal conductivity decreased with increasing temperature and showed some hysteresis in the initial heating cycle. After the first cycle, the thermal conductivity decreased from about 1.32 W/m.K at 350°K to 1.27 W/m.K at 475°K.

18451 (PNL—2854) **Assessment of effectiveness of geologic isolation systems. Geologic factors in the isolation of nuclear waste: evaluation of long-term geomorphic processes and catastrophic events.** Mara, S.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1980. Contract EY-76-C-06-1830. 54p. Dep. NTIS, PC A04/MF A01.

SRI International has projected the rate, duration, and magnitude of geomorphic processes and events in the Southwest and Gulf Coast over the next million years. This information will be used by the Department of Energy's Pacific Northwest Laboratory (PNL) as input to a computer model, which will be used to simulate possible release scenarios and the consequences of the release of nuclear waste from geologic containment. The estimates in this report, although based on best scientific judgment, are subject to considerable uncertainty. An evaluation of the Quaternary history of the two study areas revealed that each had undergone geomorphic change in the last one million years. Catastrophic events were evaluated in order to determine their significance to the simulation model. Given available data, catastrophic floods are not expected to occur in the two study areas. Catastrophic landslides may occur in the Southwest, but because the duration of the event is brief and the amount of material moved is small in comparison to regional denudation, such events need not be included in the simulation model. Ashfalls, however, could result in removal of vegetation from the landscape, thereby causing significant increases in erosion rates. Because the estimates developed during this study may not be applicable to specific sites, general equations were presented as a first step in refining the analysis. These equations identify the general relationships among the important variables and suggest those areas of concern for which further data are required. If the current model indicates that geomorphic processes (taken together with other geologic changes) may ultimately affect the geologic containment of nuclear waste, further research may be necessary to refine this analysis for application to specific sites.

18452 (PNL-SA—7352(Vol.1)) **Proceedings of the Task 4 Waste Isolation Safety Assessment Program second contractor information meeting.** (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1978. Contract EY-76-C-06-1830. 522p. (CONF-7810227—(Vol.1)). Dep. NTIS, PC A22/MF A01.

From 2. contractor information meeting; Seattle, WA, USA (1 Oct 1978).

Volume 1 contains the following papers: Solution Species of ^{239}Pu in Oxidizing Environments; Solution Species of ^{239}Pu in the Environment; Theoretical and Experimental Evaluation of Waste Transport in Selected Rocks; Studies of Radionuclide Availability and Migration at the Nevada Test Site Relevant to Radioactive Waste Disposal; Systematic Study of Metal Ion Sorption on Selected Geologic Media; Chromatographic K/sub d/ values of Radionuclides; Effects of Redox Potentials on Sorption of Radionuclides by Geologic Media; and Transport Properties of Nuclear Waste in Geologic Media. Individual papers were processed.

18453 (PNL-SA—7352(Vol.1), pp 97-185) **Theoretical and experimental evaluation of waste transport in selected rocks.** Silva, R.J.; Benson, L.V.; Apps, J.A. (Univ. of California, Berkeley). 1978.

From 2. contractor information meeting; Seattle, WA, USA (1 Oct 1978).

The experimental results obtained in FY 1978 in the study of rock interaction with U, Np, Pu, Am, and Cm are discussed, as well as the progress in the development and application of mass transfer codes to simulate groundwater conditions in low permeability rocks. Basalt, granite, and shale were used in the study.

18454 (PNL-SA—7352(Vol.1), pp 187-230) **Studies of radionuclide availability and migration at the Nevada Test Site relevant to radioactive waste disposal.** Tewhey, J.D.; Weed, H.C.; Coles, D.G.; Ramspott, L.D.; MacLean, S.C. (Univ. of California Livermore). 1978.

From 2. contractor information meeting; Seattle, WA, USA (1 Oct 1978).

The sorption distribution coefficient, K/sub d/, of a nuclide is defined as the concentration of a nuclide on a solid phase divided by its concentration in the liquid phase subsequent to equilibrium being attained. In the case of batch K/sub d/ measurements done in the laboratory, it is difficult to ascertain the extent of equilibration, and experiments may not reflect true K/sub d/ values. Kurt Wolfsberg of Los Alamos Scientific Laboratory has referred to laboratory K/sub d/ measurements as distribution ratios or R/sub d/'s. An R/sub d/ is obtained in the same manner as a K/sub d/ but does not imply equilibrium. The term R/sub d/ is used in this study. The results from the batch R/sub d/ studies are listed in tabular form. The standard deviation of the counting data for each R/sub d/ is given. The R/sub d/ values can be arranged according to the following inequalities: Pu > Cs, except for biotite; Cs > Sr, except for limestone; and Sr > Tc. The exceptions are considered significant for Pu vs Cs on biotite, but not for Cs vs Sr on limestone. The low R/sub d/ values for Tc indicate that within the limits of measurement it is not sorbed under the experimental conditions in this study. One possible cause for the negative values is preferential sorption of the sample on the walls of the sample container, so that the sample container sorbs less Tc than the blank container does.

18455 (PNL-SA—7352(Vol.1), pp 405-508) **Transport properties of nuclear wastes in geologic media. Annual report, October 1, 1977-September 30, 1978.** Seitz, M.G.; Rickert, P.G.; Fried, S.M.; Friedman, A.M.; Steindler, M.J. (Argonne National Lab., IL). 1978.

From 2. contractor information meeting; Seattle, WA, USA (1 Oct 1978).

Laboratory experiments were performed with nuclides of strontium, tin, cesium, plutonium, and americium to determine their migration characteristics in rocks from formations that may be suitable for geologic repositories for nuclear waste. Infiltration experiments have been performed at high pressures and at different solution flows, using columns of massive porous rock, porous beds of granulated minerals, or impermeable rock having fissures. Experimental results obtained this year confirm results obtained in the previous year - that nuclides migrating by fluid flow in rock often exhibit complex behavior (bleeding, dispersion of nuclide velocities, etc.) not predicted by simple chromatographic-type models. Experimental results this year, obtained using two radically different geologic media (mineral sand and rock fissures), were in agreement with a migration model which considers the kinetics of nuclides reacting with the solution and geologic media.

18456 (PNL-SA—7352(Vol.2)) **Proceedings of the Task 4 Waste Isolation Safety Assessment Program second contractor information meeting.** (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1978. Contract EY-76-C-06-1830. 494p. (CONF-7810227—(Vol.2)). Dep. NTIS, PC A21/MF A01.

From 2. contractor information meeting; Seattle, WA, USA (1 Oct 1978).

Volume II contains the following papers: Laboratory Studies of Radionuclide Distributions between Selected Groundwaters and Geologic Media; Applicability of Microautoradiography to Sorption Studies; The Kinetics and Reversibility of Radionuclide Sorption Reactions with Rocks; Mobility and Sorption Processes of Radioactive Waste Materials in Subsurface Migration; Batch K/sub d/ Experiments with Common Minerals and Representative Groundwaters; Cesium and Strontium Migration in Unconsolidated Geologic Material; Statistical Investigation of the Mechanics Controlling Radionuclide Sorption; The ARDISC Model - A Computer Program to Calculate the Distribution of Trace Element Migration in Partially-Equilibrating Media; and Some Geochemical Aspects of the Canadian Nuclear Waste Disposal System. Individual papers were processed.

18457 (PNL-SA—7352(Vol.2), pp 161-218) **Kinetics and reversibility of radionuclide sorption reactions with rocks. Progress report for fiscal year 1978.** Barney, G.S.; Anderson, P.D. (Rockwell International, Richland, WA). 1978.

From 2. contractor information meeting; Seattle, WA, USA (1 Oct 1978).

Sorption reactions of environmentally significant radionuclides with rocks from proposed waste repository sites were examined. The kinetics and reversibility of sorption were studied by measuring the distribution of radioactive tracers between synthetic groundwaters and crushed basalt, granite, and argillite in batch experiments. The initial rapid sorption reaction is followed by a slow reaction which results from changes in the composition of the rock surface and bulk solution. Equilibrium concentrations of radionuclides were not reached even after 91 days. Dissolution of some rock components is also incomplete after this time. A relatively large amount of silica is dissolved in groundwaters contacted with basalt due to dissolution of the glassy phase of the basalt sample. This silica

appears to increase the solubility of plutonium and americium. Artificially weathering basalt greatly increases the sorption capacity for each of the radionuclides studied. Weathering of granite had no observable effect on sorption. However, weathered argillite sorbs cesium, plutonium, and americium more strongly than unweathered argillite. Several irreversible sorption reactions were identified. Cesium is irreversibly sorbed on granite and ruthenium is irreversibly sorbed on basalt, granite, and argillite. Strontium and neptunium sorption are reversible for each rock type.

18458 (PNL-SA—7352(Vol.2), pp 219-258) **Mobility and sorption processes of radioactive waste materials in subsurface migration.** Eichholz, G.G.; Wahlig, B.G. (Georgia Inst. of Tech., Atlanta). 1978.

From 2. contractor information meeting; Seattle, WA, USA (1 Oct 1978).

The present work has been directed to the study of two related phenomena: the movement of submicron particles of a type expected near disposal sites through aquifers of appropriate characteristics, and the sorption processes associated with the uptake of waste ions in trace concentrations on submicron particles and the measurement of subsequent partition coefficients leading to competitive transfer from the particles to surrounding media. Because of the late date of finalization of the research contract and, hence, the limited manpower devoted to this project until recently, the results obtained so far are largely preliminary in nature. Work done has included some of the following: setting up of two types of columns with detector systems; determination of sensitivity and spatial resolution of the collimated GM and scintillation detectors; preparation of suspensions of kaolin particles; measurement of particulate movements through the bed with neutron-activated particles; determination of the Pu-237 γ-ray spectrum; and planning of the next phases of the work, using several columns and a larger research group. The results obtained so far illustrate the kind of differential movement between soluble tracers and active particulates that takes place in a permeable rock medium. It is hoped to obtain more definite results on the parameters concerned in the near future.

18459 (PNL-SA—7352(Vol.2), pp 259-332) **Batch Kd determinations with common minerals and representative groundwaters.** Relyea, J.F.; Ames, L.L.; Serne, R.J.; Fulton, R.W.; Washburne, C.D. (Battelle Pacific Northwest Labs., Richland, WA). 1978.

From 2. contractor information meeting; Seattle, WA, USA (1 Oct 1978).

Adsorption and desorption Kd's have been determined for seven elements (Pu, Am, I, Tc, Cs, Np, Sr) in tracer concentrations using four simulated groundwaters and twelve minerals (illite, kaolinite, montmorillonite, vermiculite, biotite, quartz, albite, anorthite, microcline, hornblende, enstatite, augite) in all their 336 combinations. System parameters have been measured in an attempt to characterize each system in as complete a manner as possible. The mineralogy and chemical composition of each mineral used have been determined (both before and after crushing bulk samples). Eh and pH have been measured for each system. The mineral-solution effluent is presently being analyzed using effluent from experiments without tracers. The data generated will be analyzed by Adaptronics to produce empirical equations for Kd's which will be used in models to predict nuclide migration in geologic media. Multiple oxidation state elements have been found to behave differently than single oxidation state elements in certain situations. Research beyond the scope of this study is required to determine the cause of this anomalous behavior (specifically: Tc, Np and Pu). To obtain an understanding of adsorption phenomenon under reducing conditions in geologic media, the batch Kd determinations just described will be carried out under anoxic and reducing conditions with the same nuclides, minerals and solutions.

18460 (PNL-SA—7352(Vol.2), pp 333-425) **Statistical investigation of the mechanics controlling radionuclide sorption. Part II. Final technical report.** Mucciardi, A.N.; Booker, I.J.; Orr, E.C.; Cleveland, D. (Adaptronics, Inc., McLean, VA). 1978.

From 2. contractor information meeting; Seattle, WA, USA (1 Oct 1978).

The results in this report demonstrate the feasibility of modeling empirically the transport of radionuclides (sorption coefficient, K/sub d/) in several geologic media/groundwater solution environments. Nonlinear Adaptive Learning Network models were synthesized to predict adsorption and desorption K/sub d/'s for seven radionuclides as a function of 16 minerals and four groundwaters. The major results reported here are comparisons between the actual K/sub d/'s and those predicted by the models, and a rank-ordering of the importance of the geologic medium/solution variables per nuclide K/sub d/ model.

18461 (PNL-SA—7352(Vol.2), pp 429-435) **ARDISC Model: a computer program to calculate distribution of trace element migration in partially-equilibrating media.** Strickert, R. (Battelle Pacific Northwest Labs., Richland, WA). 1978.

From 2. contractor information meeting; Seattle, WA, USA (1 Oct 1978).

The computer model used is similar to the standard mixing model, in which a one-dimensional box is divided into zones. Each zone can sorb a solute such that, at equilibrium, the distribution of the species between the surface of the zone and the volume of the solution is α/β, where α = the relative amount of species on the surface, and $\beta = 1 - \alpha$. Following this distribution, the solution from one zone is transferred to the next zone and another equilibrium distribution cycle can occur, and so on for additional cycles and zones. To incorporate a kinetic effect into this migrational model, the α/β distribution was modified.

18462 (PNL-SA—7352(Vol.2), pp 437-445) **Some geochemical aspects of the Canadian nuclear waste disposal program.** Vandergraaf, T. (Atomic Energy of Canada, Pinawa, Manitoba). 1978.

From 2. contractor information meeting; Seattle, WA, USA (1 Oct 1978).

The Canadian disposal program concept calls for the disposal of radioactive wastes in a deep underground repository in an igneous intrusion (pluton) in the Canadian Precambrian Shield. The experiment program involves exploratory drilling and radionuclides adsorption studies. The main interest is in measuring surface adsorption coefficients for 20 radioactive elements on force rock types as a function of time, temperature, groundwater composition, and aging of the rock.

18463 (RHO-BWI—80-100-19) **Basalt Waste Isolation Project. Quarterly report, October 1, 1979-December 31, 1979.** (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). Jan 1980. Contract EY-77-C-06-1030. 84p. Dep. NTIS, PC A05/MF A01.

Progress in geology and hydrology is reported. Engineered barrier experiments with spent fuel indicate that basalt favorably affects the repository performance: experiments leaching simulated spent fuel alone remove 90 to 100% of the cesium, rubidium, and molybdenum present, while leaching in the presence of basalt produced residual solutions containing less than 10% of these cations. The following alloys appear to be best for use as a waste canister and/or overpack in a basalt environment: Ticode 12, Hastelloy C-276, Inconel 625, Incoloy 825, and 90-10 Cupronickel. The Title II design of the Bottom Loading Transporter was completed this quarter. The design of the heaters for Block Tests No. 1 and No. 2 was completed.

18464 (RHO-BWI-SA—19) **Status report on studies to assess the feasibility of storing nuclear waste in Columbia plateau basalts.** Deju, R.A. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). Jul 1979. Contract EY-77-C-06-1030. 18p. (IAEA-SM—243/36; CONF-790711—5). Dep. NTIS, PC A02/MF A01.

From International symposium on underground disposal of radioactive wastes; Otaniemi, Finland (2 Jul 1979).

Basalts, such as the Columbia Plateau basalts, which underlie a large portion of the Pacific Northwest and the Hanford Site, were selected for initial geologic reconnaissance. Geologic exploration of Columbia Plateau basalts was needed to determine the feasibility of utilizing those formations as a site for terminal storage of commercial nuclear waste. The Basalt Waste Isolation Program within Rockwell Hanford Operations has been chartered with the responsibility of conducting these investigations. This program is divided into systems integration, geology, hydrology, engineered barriers studies, engineering testing, and the construction of a near-surface test facility.

18465 (RHO-BWI-SA—30) **Strain distribution and model for formation of eastern Umtanum Ridge anticline, south-central Washington.** Price, E.H. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Oct 1979. Contract EY-77-C-06-1030. 27p. (CONF-800342—3). Dep. NTIS, PC A03/MF A01.

From 76. annual meeting Cordilleran Section Geological Society of America; Corvallis, OR, USA (19 Mar 1980).

Umtanum Ridge in south-central Washington is the topographic expression of a complex anticline within the Yakima Fold system in the Miocene Columbia River Basalt Group. The Yakima Fold system, which is partly contained within the Hanford Site, is an example of a layered basalt sequence folded near the surface of the earth. The Pasco Basin stratigraphic nomenclature is used in this repot. Rockwelll Hanford Operations, under contract to the US Department of Energy, is investigating the feasibility of therminal high-level nuclear waste storage in mined repositories in basalt beneath the Hanford Site. Because thereis essentially no basalt within the Site that has not been involved in some folding, any potential location for a repository will be either on the limbs or near the hinge zone of a Yakima Fold structure. Umtanum Ridge is the best exposed Yakima Fold structure in the vicinity of the Site for studying the nature and three-dimensional style of deformation of a multilayered basalt sequence. The structural geometry, distribution

of strain within the Umtanum structure and deformational mechanisms of the Umtanum Ridge are discussed.

18466 (RHO-C—22) **Strength and elastic properties of concretes from waste tank farms.** Gillen, M. (Portland Cement Association, Skokie, IL (USA). Construction Technology Labs.). Dec 1978. Contract EY-77-C-06-1030. 59p. Dep. NTIS, PC A04/MF A01.

Tests were conducted on concretes from Hanford Waste Tank Farms, and on concrete cast by the Portland Cement Association using Hanford mix designs and materials. Elastic modulus (static method), Poisson's ratio, and compressive and splitting tensile strengths were determined at room temperature, and for specimens maintained at 250F for varying lengths of time. Variables examined were temperature, length of exposure to elevated temperature, and geometry of test specimens. Compressive strength generally decreased after specimens were exposed to heat. Maximum losses were 20 to 33 percent of room temperature strength. Initially stronger concretes lost a proportionately larger percentage of their strength after exposure than did weaker concrete. In some series, concrete appeared to gain strength after exposure. In other series, concrete initially lost strength, then recovered strength after prolonged heating. Splitting tensile strength of heated specimens followed trends similar to those obtained for compressive strength. Highest strength losses were about 40 percent. However, in most cases, considerably less strength deterioration resulted from exposure to heat. Modulus of elasticity and Poisson's ratio also decreasd after exposure to heat. Greatest losses were about 40 percent of room temperature values, but amounts differed widely among test series.

18467 (RHO-LD—71) **Stratigraphy of the late Cenozoic sediments beneath the 216-A Crib Facilities.** Fecht, K.R.; Last, G.V.; Marratt, M.C. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Feb 1979. Contract EY-77-C-06-1030. 168p. Dep. NTIS, PC A08/MF A01.

The stratigraphy of the late Cenozoic sediments beneath the 216-A Crib Facilities is presented as lithofacies cross sections and is based on textural variations of the sedimentary sequence lying above the basalt bedrock. The primary source of data in this study is geologic information obtained from well drilling operations and geophysical logging. Stratigraphic interpretations are based primarily on textural analysis and visual examination of sediment samples and supplemented by drillers logs and geophysical logs.

18468 (RHO-LD—100) **Heat transfer analysis for a loss of institutional control event at the Waste Encapsulation and Storage Facility.** Allen, G.K. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Sep 1979. Contract EY-77-C-06-1030. 21p. Dep. NTIS, PC A02/MF A01.

A heat transfer analysis was made for a hypothetical loss of institutional control accident at the WESF 100 years after implementation of the Continued Present Action alternative. Three separate storage configurations were studied. The storage configuration with the maximum number of capsules per storage rack produced maximum capsule temperatures of 2475°F and maximum concrete temperatures of 2435°F. The storage configuration with the minimum number of capsules per storage rack produced maximum capsule temperatures of 1030°F and maximum concrete temperatures of 1011°F. These maximum temperatures will be reached in less than 2.5 years after loss of cooling water. The time required to boil a storage pool dry for the maximum number of capsules per storage rack was calculated to be 48 days; for the minimum number of capsules per storage rack, 190 days.

18469 (SAND—78-1147) **Preliminary thermal expansion screening data for tuffs.** Lappin, A.R. (Sandia Labs., Albuquerque, NM (USA)). Mar 1980. Contract AC04-76DP00789. 40p. Dep. NTIS, PC A03/MF A01.

A major variable in evaluating the potential of silicic tuffs for use in geologic disposal of heat-producing nuclear wastes is thermal expansion. Results of ambient-pressure linear expansion measurements on a group of tuffs that vary treatly in porosity and mineralogy are presente here. Thermal expansion of devitrified welded tuffs is generally linear with increasing temperature and independent of both porosity and heating rate. Mineralogic factors affecting behavior of these tuffs are limited to the presence or absence of cristobalite and altered biotite. The presence of cristobalite results in markedly nonlinear expansion above 200°C. If biotite in biotite-hearing rocks alters even slightly to expandable clays, the behavior of these tuffs near the boiling point of water can be dominated by contraction of the expandable phase. Expansion of both high- and low-porosity tuffs containing hydrated silicic glass and/or expandable clays is complex. The behavior of these rocks appears to be completely dominated by dehydration of hydrous phases and, hence, should be critically dependent on fluid pressure. Valid extrapolation of the ambient-pressure results presented here to depths of interest for construction of a nuclear-waste repository will depend on a good understanding of the interaction of dehydration rates and fluid pressures, and of the effects of both micro- and macrofractures on the response of tuff masss.

18470 (SAND—79-2117C) **Biological ramifications of the subseabed disposal of high-level nuclear waste.** Gomez, L.S.; Hessler, R.R.; Jackson, D.W.; Marietta, M.G.; Smith, K.L. Jr.; Talbert, D.M.; Yayanos, A.A. (Sandia Labs., Albuquerque, NM (USA); Scripps Institution of Oceanography, La Jolla, CA (USA); Falcon Research and Development, Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 30p. (CONF-800420—1). Dep. NTIS, PC A03/MF A01.

From 2. international ocean disposal symposium; Woods Hole, MA, USA (15 Apr 1980).

Portions of document are illegible.

The primary goal of the US Subseabed Disposal Program (SDP) is to assess the technical and environmental feasibility of disposing of high-level nuclear waste in deep-sea sediments. The subseabed biology program is charged with assessing possible ecosystem effects of radionuclides as well as possible health effects to man from radionuclides which may be released in the deep sea and transported to the ocean surface. Current biological investigations are attempting to determine benthic community structure; benthic community metabolism; the biology of deep-sea mobile scavengers; the faunal composition of midwater nekton; rates of microbial processes, and the radiation sensitivity of deep-sea organisms. Existing models of the dispersal of radionuclides in the deep sea have not considered many of the possible biological mechanisms which may influence the movement of radionuclides. Therefore, a multi-compartment foodweb model is being developed which considers both biological and physical influences on radionuclide transport. This model will allow parametric studies to be made of the impact on the ocean environment and on man of potential releases of radionuclides.

18471 (SAND—80-0310C) **Finite element analysis of thermal convection in deep ocean sediments.** Gartling, D.K. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 15p. (CONF-800515—1). Dep. NTIS, PC A02/MF A01.

From 3. international conference on finite elements in water resources; Oxford, MS, USA (19 May 1980).

Of obvious importance to the study and engineering of a seabed disposal is the determination of the temperature and fluid flow fields existing in the sediment layer and the perturbation of these fields due to the implantation of localized heat sources. The fluid mechanical and heat transfer process occurring in oceanic sediments may be characterized as free (or natural) convection in a porous material. In the case of an undisturbed sediment layer, the driving force for the natural circulation of pore water comes from the geothermal heat flux. Current theories for heat flow from the sea floor suggest the possibility of large scale hydrothermal circulation in the oceanic crust (see e.g., Ribando, et al. 1976) which is in turn coupled with a convection process in the overlying sediment layer (Anderson 1980, Anderson, et al. 1979). The introduction of a local heat source, such as a waste canister, into a saturated sediment layer would by itself initiate a convection process due to buoyancy forces. Since the mathematical description of natural convection in a porous medium is of sufficient complexity to preclude the use of most analytic methods of analysis, approximate numerical procedures are often employed. In the following sections, a particular type of numerical method is described that has proved useful in the solution of a variety of porous flow problems. However, rather than concentrate on the details of the numerical algorithm the main emphasis of the presentation will be on the types of problems and results that are encountered in the areas of oceanic heat flow and seabed waste disposal.

18472 (SAND—80-0323C) **Technical issues in the geologic disposal of radioactive wastes.** Weart, W.D. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 10p. (CONF-800517—2). Dep. NTIS, PC A02/MF A01.

From 26. annual technical meeting of the Institute for Environmental Sciences; Philadelphia, PA, USA (11 May 1980).

The status of technical understanding regarding radioactive waste repositories in geologic media is improving at a rapid rate. Within a few years the knowledge regarding non-salt repositories will be on a par with that which now exists for salt. To date there is no technical reason to doubt that geologic repositories in several different geologic media can be safely implemented to provide long-term isolation of radioactive wastes. Indeed, for bedded salt, there is now sufficient knowledge to allow all the identified phenomena to be bounded with satisfactory resultant consequences. It is possible to now proceed with technical confidence in an orderly development of a bedded-salt repository at a satisfactory site. This development would call for in-situ experiments, at the earliest possible stage, to confirm or validate the predictions made for the site. These in-situ experiments will be necessary for each repository in a different rock type. If, for non-technical reasons, repository development is delayed, field test facilities should be located as soon as possible in geologic settings typical of proposed repositories. Extensive testing to resolve generic issues will allow subsequent development of repositories to proceed more rapidly with only minimal in-situ testing required to resolve site-specific concerns.

18473 (UCRL—15203) **Geologic, stratigraphic, thermal, and mechanical factors which influence repository design in the bedded salt environment.** Ashby, J.P.; Nair, O.; Ortman, D.; Rowe, J. (Golder Associates, Inc., Kirkland, WA (USA)). Dec 1979. Contract W-7405-ENG-48. 89p. Dep. NTIS, PC A05/MF A01.

This report describes the geologic, stratigraphic, thermal, and mechanical considerations applicable to repository design. The topics discussed in the report include: tectonic activity; geologic structure; stratigraphy; rock mechanical properties; and hydrologic properties.

18474 (UCRL—15205) **Effects of resource activities upon repository siting and waste containment with reference to bedded salt.** Ashby, J.; Rowe, J. (Golder Associates, Inc., Kirkland, WA (USA)). Feb 1980. Contract W-7405-ENG-48. 66p. Dep. NTIS, PC A04/MF A01.

The primary consideration for the suitability of a nuclear waste repository site is the overall ability of the repository to safely contain radioactive waste. This report is a discussion of the past, present, and future effects of resource activities on waste containment. Past and present resource activities which provide release pathways (i.e., leaky boreholes, adjacent mines) will receive initial evaluation during the early stages of any repository site study. However, other resource activities which may have subtle effects on containment (e.g., long-term pumping causing increased groundwater gradients, invasion of saline water causing lower retardation) and all potential future resource activities must also be considered during the site evaluation process. Resource activities will affect both the siting and the designing of repositories. Ideally, sites should be located in areas of low resource activity and low potential for future activity, and repository design should seek to eliminate or minimize the adverse effects of any resource activity. Buffer zones should be created to provide areas in which resource activities that might adversely affect containment can be restricted or curtailed. This could mean removing large areas of land from resource development. The impact of these frozen assets should be assessed in terms of their economic value and of their effect upon resource reserves. This step could require a major effort in data acquisition and analysis followed by extensive numerical modeling of regional fluid flow and mass transport. Numerical models should be used to assess the effects of resource activity upon containment and should include the cumulative effects of different resource activities. Analysis by other methods is probably not possible except for relatively simple cases.

18475 (USGS-OFR—80-126) **Borehole geophysical measurements for Hole UE25a-3, Nevada Test Site, Nuclear Waste Isolation Program.** Daniels, J.J.; Scott, J.H. (Geological Survey, Washington, DC (USA)). 1980. Contract EW-78-I-08-1543. 31p. Dep. NTIS, PC A03/MF A01.

Borehole geophysical measurements made in drill hole UE25a-3 with a US Geological Survey research well-logging truck are presented in this paper. The purpose of these logging measurements is to provide in-situ physical properties information that is not commercially available on drill hole UE25a-3. Well logs are presented in this paper for dual-detector density, normal resistivity, gamma-ray, neutron-neutron, induced polarization, and magnetic susceptibility measurements. These data are analyzed correlations with the core lithology. Hole-to-surface measurements made from drill hole UE25a-3 indicate the presence of two resistive bodies at depth. The deeper resistive anomaly may be related to a granitic intrusion.

18476 **Nuclear waste--does burying it bury the problem.** Thomas, R.A. *Eng. Min. J.;* **180**: No. 7, 131-134(Jul 1979).

This article discusses the Department of Energy (DOE)'s undergrounsd nuclear waste repository which is scheduled for startup in 1981 in New Mexico, and tries to explain why this project is being plagued by delays and uncertainties. The facility, known as the Waste Isolation Pilot Plant (WIPP), faces such problems as the question of the geologic security of the tentative site, citizens' objections about the location, as well as some licensing problems and concerns about overland transport of the large amounts of highly radioactive wastes that will fill the repository.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 18383, 18447, 18452, 18453, 18454, 18455, 18456, 18457, 18458, 18459, 18460, 18461, 18462, 19199, 19200

18477 (DP-TR—10) **Behavior in underground environments of uranium and thorium discharged by the nuclear industry.** Rancon, D. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. de Protection). [nd]. Translation of IAEA-SM—172/55, 1973. 13p. Dep. NTIS, PC A02/MF A01.

Following various studies on the radioactive contamination of soil by fission products from a variety of effluents, it has been found necessary to establish the manner in which long-lived heavy radionuclides could be diffused in underground environments. A proposal is made to study the behavior in the soil of extrinsic uranium and thorium, in contrast to uranium and thorium existing as natural components of the soil. Various types of soil were used (acid and alkaline) and various minerals (clays, limestones, quartz). Uranium in solution, or the uranyl ion, has some degree of mobility in the soil. The coefficient for distribution of uranyl ions between solution and solid phase was measured at various concentrations. The influence of pH of the soil-water solution is significant; retention of uranium by soil shows a marked increase within some narrow pH ranges. Thorium is subject to high retention by clayey and limestone soils, some of the latter strongly fixing the entire amount. The influence of various parameters (pH, concentration, soil composition) is also substantial, since retention can be greatly reduced under certain extreme conditions. The risk of the dissemination of thorium in dilute solutions over long distances is negligible in most soils. On the other hand, some degree of uranium diffusion under the influence of ground-water movements should be anticipated; diffusion assessments are presented.

18478 (PNL-SA—7352(Vol.1), pp 331-403) **Chromatographic K/sub d/ values of radionuclides and the effect of redox potentials on sorption of radionuclides by geologic media.** Francis, C.W.; Reeves, M. III; Bondietti, E.A.; Smith, B.A. (Oak Ridge National Lab., TN). 1978.

From 2. contractor information meeting; Seattle, WA, USA (1 Oct 1978).

Distribution and selectivity coefficients for ^{85}Sr and ^{63}Ni were determined in the presence of various Ca concentrations in channel chromatographs packed with Conasauga shale. These coefficients were obtained using a coupled-equations model consisting of (1) moisture transport in a partially saturated media, (2) mass transport of the calcium and radionuclide species contained in the influent, and (3) ion exchange between the ionic species in the solution phase and those sorbed on the solid matrix. A normalization procedure was developed so that profile data from one column or channel could be compared to data from other channels. Dispersivity measurements in the channel chromatographs were found to be the largest source of error in determining K/sub d/ values. Values for ^{85}Sr ranged from 2.4 to 3.6 and for ^{63}Ni from 5.3 to 8.6, and compared closely to those determined by a batch equilibrium method, 2.4 for ^{85}Sr and 6.5 for ^{63}Ni. Redox measurements of igneous rock suspensions in anoxic stirred cells predicted that the species of TcO_4^- and NpO_2^+ would not be the stable forms of these elements. Adding T/sub c/O_4- and NpO_2^+ to similar anoxic suspensions revealed that the species are reduced to less soluble states. Thus, current risk assessments, which consider the oxidized forms (TcO_4^- and NpO_2^+) as potentially migrating from high-level radioactive waste repositories, may be overestimating their potential hazard to the public.

18479 (SGAE—2915) **Environmental radiation monitoring of nuclear sites by thermoluminescent dosimeters (TLD).** Duftschmid, K.E.; Strachotinsky, C. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna). Apr 1978. 68p. (In German). (ST—79/78). Dep. NTIS (US Sales Only), PC A05/MF A01.

The measurement of environmental radiation doses around nuclear facilities requires the detection of few mrem/year. The properties of the automatic TLD-system Harshaw Mod. 2271 for such measurements have been evaluated under practical conditions and optimized techniques derived. The automatic TLD-system is based on LiF dosimeter cards with two crystals providing gamma and beta dose values. Limit of detection defined as three standard deviations of residuel dose is 1,2 mR. Automatic readout combined with electronic data evaluation are especially useful for large monitoring networks. Practical intercomparisons of this dosimeter with bulb-type CaF_2 detectors have been performed showing good agreement of both detector. Although bulb-dosimeters proved to be extremely sensitive with a limit of detection at 0.012 mR which makes them very suitable for very short exposure times, the automatic LiF system is superior in regards of man power requirement if monthly monitoring periods are sufficient. The system has been tested in practice during two international intercomparisons performed by the US Department of Energy - Health and Safety Laboratory New York and the Physikalisch Technische Bundesanstalt Braunschweig, Germany, showing excellent agreement. Furthermore a routine monitoring network consisting of 12 measurement positions around the Research Center Seibersdorf has been operated with this technique since more than two years.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 18452, 18456, 19503, 19644, 19645, 19703

18480 (PNL-SA—6795) **Summary of current practices at several DOE facilities for maintaining exposures to as low as practicable.** Gilchrist, R.L.; Selby, J.M.; Wedlick, H.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1978. Contract EY-76-C-06-1830. 9p. (CONF-780657—8). Dep. NTIS, PC A02/MF A01.

From 23. meeting of the Health Physics Society; Minneapolis, MN, USA (18 Jun 1978).

The results of a study initiated by Battelle-Northwest to determine the extent of the development and use of As Low As Practicable (ALAP) guidelines at several DOE facilities show a wide variance in methods for attempting to achieve a good ALAP program. The information obtained from interviews and on-site visits was collated and found to contain several areas where greater attention may be required. These areas range from a need for identification of risks assumed by management to an improved method for data feedback. The various approaches to achieving ALAP and areas requiring greater attention, together with a forthcoming manual, A Guide to Good ALAP Practices, will be discussed.

18481 (UCRL—52786) **Seismic safety of the LLL plutonium facility (Building 332).** Torkarz, F.J.; Shaw, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Jan 1980. Contract W-7405-ENG-48. 70p. Dep. NTIS, PC A04/MF A01.

This report states the basis for the Lawrence Livermore Laboratory's assurance to the public that the plutonium operations at the Laboratory pose essentially no risk to anyone's health or safety, either under normal circumstances or in the event of an earthquake or a fire. The report is intended for a general audience, and so for the most part it is not highly technical. It summarizes the steps taken to ensure the seismic safety of the plutonium facility (Bldg. 332). It describes plutonium and its potential hazard and how the facility copes with that hazard. It recounts the geologic investigations and interpretations that led to the design-basis earthquake (DBE) for the Livermore site, and presents a summary analysis of the facility structure in relation to the DBE. An appendix presents a quantitative calculation of the health risk to the public associated with the worst-case hypothetical fire. The document supports the conclusions that the facility will continue to function safely after the maximum earthquake ground motion to which it may be subjected and that there is no evidence of a potential for surface offset under it.

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 18883, 19171, 19172

18482 (DP-MS—79-43) **Evaluation of an L/sub III/ x-ray absorption-edge densitometer for assay of mixed uranium-plutonium solutions.** Mosley, W.C.; Thompson, M.C.; Reynolds, L.W.; Russo, P.; Canada, T.R.; Langner, D.G. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.; Los Alamos Scientific Lab., NM (USA)). 1979. Contract EY-76-C-09-0001. 19p. (CONF-791117—21). Dep. NTIS, PC A02/MF A01.

From ANS topical conference; Kiawah Island, SC, USA (26 Nov 1979).

An L/sub III/ x-ray absorption-edge densitometer (XRAED), designed and built at Los Alamos Scientific Laboratory, has been evaluated at Savannah River Laboratory for the assay of uranium and plutonium in process solutions. Fro 2000-second data collection, the precisions (95% confidence level) for uranium assays varied +- 1.04% at 10 g of uranium per liter to 0.34% at 45 g/L, and plutonium assays varied from +- 6.7% at 2 g of plutonium per liter to +- 2.2% at 10 g/L. Hydroxylamine nitrate, a reducing agent used in solvent extraction tests, affect the accuracies of both uranium and plutonium assay by densitometry, and plutonium analysis by coulometry. It appears that the XRAED could be used to control the SRL miniature mixer-settlers, but additional testing will be needed to demonstrate that XRAED accuracy is sufficient for accountability of special nuclear materials.

18483 (DP-MS—79-54) **Shield system.** Finch, D.R.; Chandler, J.R.; Church, J.P. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1979. Contract EY-76-C-09-0001. 19p. (CONF-791103—74). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Portions of document are illegible.

The SHIELD system is a powerful new computational tool for calculation of isotopic inventory, radiation sources, decay heat, and shielding assessment in part of the nuclear fuel cycle. The integrated approach used in this system permitss the communication and management of large fields of numbers efficiently thus permitting the user to address the technical rather than computer aspects of a problem. Emphasis on graphical outputs permits large fields of resulting numbers to be efficiently displayed.

18484 (LA—8274-PR) **Evaluation of in-line nondestructive assay systems. Progress report, October 1-December 31, 1979.** Bowersox, D.F.; Ensslin, N.; Hsue, S.T.; Johnson, S.S.; Speir, L.G.; Spirio, C.A.; Tape, J.W.; Walton, G.; Walton, R.B. (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 15p. Dep. NTIS, PC A02/MF A01.

The characteristics of the experimental neutron counter are described. The counter is designed to handle the high counting rates present for up to several kilograms of plutonium. Spontaneous data are given for ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, and ^{242}Pu.

18485 (LA-UR—80-801) **Development of in-line plutonium solution NDA instrumentation at the Savannah River Plant .** Smith, H.A. Jr.; Marks, T.; Cowder, L.; Shonrock, C.; Johnson, S.; Slice, R.; Sprinkle, J.; MacMurdo, K.W.; Pollard, R.L.; Baker, L.B. (Los Alamos Scientific Lab., NM (USA); Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Mar 1980. Contract W-7405-ENG-36. 5p. (CONF-800315—7). Dep. NTIS, PC A02/MF A01.

From 2. symposium of the European Safeguards Research and Development Association; Edinburgh, UK (26 Mar 1980).

A K-absorption-edge plutonium solution densitometer has been developed by the Los Alamos Scientific Laboratory for in-line test and evaluation in the process line at the Savannah River Plant. The design features of the measurement system, the measurement principles, and performance data are presented.

18486 (LA-UR—80-802) **Gas-phase UF_6 enrichment monitor for enrichment plant safeguards.** Strittmatter, R.B.; Tape, J.W. (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 5p. (CONF-800315—8). Dep. NTIS, PC A02/MF A01.

From 2. symposium of the European Safeguards Research and Development Association; Edinburgh, UK (26 Mar 1980).

An in-line enrichment monitor is being developed to provide real-time enrichment data for the gas-phase UF_6 feed stream of an enrichment plant. The nondestructive gamma-ray assay method can be used to determine the enrichment of natural UF_6 with a relative precision of better than 1% for a wide range of pressures.

18487 (MLM—2668(OP)) **CUA and performance criterion: a mathematical example.** Armstrong, D.B.; Rogers, D.R. (Mound Facility, Miamisburg, OH (USA)). 29 Feb 1980. Contract EY-76-C-04-0053. 142p. Dep. NTIS, PC A07/MF A01.

CUA is the Controllable Unit Approach to Material Control. It is a system being developed to help NRC with regulations for implementing the absolute performance criterion for controlling SNM in nuclear facilities. Purpose of this slide presentation is to provide a detailed demonstration of the CUA methodology. A performance criterion was defined, a hypothetical process was defined, and a closure equation network was developed and modified until the performance criterion was met for four diversion types. (DLC)

18488 (UCRL—82212) **Aggregated systems model: a tool for nuclear safeguards decision-making.** Al-Ayat, R.; Judd, B.; Huntsman, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.; Applied Decision Analysis, Inc., Menlo Park, CA (USA)). 4 Oct 1979. Contract W-7405-ENG-48. 9p. (CONF-800315—5). Dep. NTIS, PC A02/MF A01.

From 2. symposium of the European Safeguards Research and Development Association; Edinburgh, UK (26 Mar 1980).

Setting performance criteria for systems that safeguard special nuclear material (SNM) involves many considerations: characteristics of adversaries attempting to divert SNM, safeguards response to attempts, costs of safeguards systems, and the consequences of diverted SNM. This paper describes an Aggregated Systems Model which is designed to assist decision makers integrate and evaluate consistently these diverse factors. Results from applying the model to a hypothetical facility handling SNM are summarized. The paper also describes a new performance criterion designed to measure the effectiveness of a safeguard system in deterring adversaries.

ADMINISTRATIVE AND REGULATORY

REFER ALSO TO CITATION(S) 19267

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

PHYSICAL ISOTOPE SEPARATION

HEAVY WATER PRODUCTION

18489 (UCID—17736-79-4) **Development of advanced concepts for improved heavy water production technology. Quarterly report,**

October 1-December 31, 1979. Aldridge, F.T.; Herman, I.P.; Marling, J.B.; Wood, L.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Feb 1980. Contract W-7405-ENG-48. 31p. Dep. NTIS, PC A03/MF A01.

During the last quarter, work continued on deuterium separation by metal hydride chromatography and by CO_2 laser multiple-photon dissociation (MPD). In the chromatographic process Ca_8Ni_4 Cu plus Ni powder mixtures were examined as possible column materials. The photochemical studies centered on further investigation of the quite promising technique of MPD of trifluoromethane.

ISOTOPIC POWER SUPPLIES

DESIGN AND FABRICATION

18490 Platinum group alloy containers for radioisotopic heat sources. Thermoelectric generators power spacecraft instruments. Inouye, H. (Oak Ridge National Lab., TN (USA)). *Platinum Met. Rev.;* **23**: No. 3, 100-108(Jul 1979).

The conversion of heat energy, resulting from the decay of plutonium-238 dioxide, to electrical energy for spacecraft requires alloys capable of containing the isotopic fuel at temperatures up to about 2000°C and of withstanding impact velocities of 90 metres per second. The development and properties of a platinum-30 per cent rhodium-8 per cent tungsten and an iridium-0.3 per cent tungsten alloy doped with 40 ppm each of thorium and aluminium, which meet the stringent service requirements, are reviewed.

HYDROGEN

18491 (CONF-791127—) **Proceedings of the DOE chemical energy storage and hydrogen energy systems contracts review.** (Jet Propulsion Lab., Pasadena, CA (USA)). Feb 1980. Contract ET-78-I-01-3112. 249p. Dep. NTIS, PC A11/MF A01.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

Sessions were held on electrolysis-based hydrogen storage systems, hydrogen production, hydrogen storage systems, hydrogen storage materials, end-use applications and system studies, chemical heat pump/chemical energy storage systems, systems studies and assessment, thermochemical hydrogen production cycles, advanced production concepts, and containment materials. (LHK)

18492 (TAC-H—79-003) **Hydrogen energy: a bibliography with abstracts. Quarterly update, July-September 1979.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Nov 1979. 124p. Univ. of New Mexico, Albuquerque.

Hydrogen energy is a continuing bibliograhic summary with abstracts of research and projections on the subject of hydrogen as a secondary fuel and as an energy carrier. This update cites 325 references identified during the third quarter of 1979. Categories covered are production, utilization, transmission, distribution, storage, safety, and materials.

PRODUCTION

18493 (CONF-791127—, pp 140-143) **Preliminary evaluation of processes for recovering hydrogen from hydrogen sulfide.** Bartlett, R.W. (SRI International, Menlo Park, CA); Cubicciotti, D.; Hildenbrand, D.L.; Macdonald, D.D.; Semrau, K.; Raymont, M.E.D. Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

A theoretical study was made of the concept of recovering hydrogen as well as sulfur from hydrogen sulfide. Hydrogen sulfide is a by-product from the desulfurization of fossil fuels. In current practice the sulfur values are recovered but the hydrogen is not. Recovery of the hydrogen, if economically feasible, would help conserve fossil fuels.

ELECTROLYSIS

REFER ALSO TO CITATION(S) 18504

18494 (CONF-791127—, pp 3-6, 6a) **Electrolysis-based hydrogen storage systems: overview and rationale of the Brookhaven National Laboratory managed program.** Mezzina, A. (Brookhaven National Lab., Upton, NY). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

The Brookhaven National Laboratory program management, monitoring and in-house research and development activities in Chemical/Hydrogen Energy Storage Systems are summarized. The program objectives aim toward development of a technological base in chemical/hydrogen storage technology while identifying near-term opportunities for technology transfer. The emphasis is on conversion of our inexhaustible resources in a cost-effective manner. Budget allocations are summarized showing electrolytic hydrogen production as the highest priority area of R and D. A Budget/Activity Summary is presented. The program organization, in accordance with a work breakdown structure, includes a newly assumed responsibility transferred from Sandia Livermore Laboratories to BNL in Chemical Energy Storage/Chemical Heat Pump Systems Development.

18495 (CONF-791127—, pp 7-10) **Development status of solid polymer electrolyte water electrolysis for large scale hydrogen generation.** Russell, J.H. (General Electric Co., Wilmington, MA). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

During 1979, progress continued on the joint Department of Energy, Electric and Gas Utility and General Electric Company sponsored development of the solid polymer water electrolysis technology for large scale hydrogen generation. This program, which is aimed at achieving significant improvements in both capital cost and conversion efficiency, has progressed to the point where systems with capabilities of 500 and 2000 SCFH hydrogen are operational and are being used to evaluate multi-cell modules of 2.5 ft^2 active area cells. The systems are described, and test results to date presented. Technology development in support of the scale up activities have resulted in several component design modifications to enhance sealing and improve performance. These design modifications are currently being incorporated into full sized hardware. Design of a 10 ft^2 active area cell - the next step in hardware scale up is in process. Manufacturing development of the 10 ft^2 is anticipated to begin in 1980 after demonstration of 2.5 ft^2 cells in a full 2000 SCFH module.

18496 (CONF-791127—, pp 11-13) **Selection and evaluation of materials for advanced water electrolyzers.** Srinivasan, S.; Yeo, R.S.; Kissel, G.; Gannon, E.; Kulesa, F.; Orehotsky, J.; Visscher, W. (Brookhaven National Lab., Upton, NY). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

Efforts are being made to find better and more stable (i) anode electrocatalysts for solid polymer electrolyte water electrolyzers and (ii) cell components (e.g., electrodes, separators) for advanced alkaline water electrolyzers. Of several mixed oxides of ruthenium examined as anode electrocatalysts in 1 N H_2SO_4, the ternary system (Ru-Ir-Ta) shows most promise. Most of these mixed oxides, prepared by the thermal decomposition method, exhibit low Tafel slopes for oxygen evolution. As with Pt and Ir, multicycling of a Ru-Ir electrode in H_2SO_4 produces a thick oxide layer, as ascertained ellipsometrically, with enhanced electrocatalytic activity for oxygen evolution. High surface area nickel or mild steel and nickel whisker electrodes reduce cell potentials for water electrolysis in alkaline electrolyte by about 100 mV. Composite barrier structures show prospects of improving chemical and mechanical stabilities of separators in alkaline electrolyte. The FY 1980 projects will consist of (i) assembly of LEED-Auger-ESCA system and development of methods to correlate electrocatalytic activity and surface properties; (ii) examination of promising ruthenium based mixed oxide electrocatalysts in single cells; (iii) electrochemical-ellipsometric investigation of Ru-Ir and Ru-Ir-Ta alloys; (iv) elucidation of role of hydrogen permeation in metals on time variation of hydrogen overpotential; (v) improvement of electrode configuration to lower overpotential losses; and (vi) examination of composite barrier materials.

18497 (CONF-791127—, pp 14-18) **New developments in alkaline water electrolysis.** Yaffe, M.R.; Murray, J.N. (Teledyne Energy Systems, Timonium, MD). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

Work toward the advancement of alkaline water electrolysis technology has proceeded at Teledyne Energy Systems (TES) under contracts BNL 380750-S and BNL 480421-S during Government Fiscal Year (GFY) 1979. Operation of asbestos electrode separator cells for over 1000 h at 100°C was demonstrated which included several short term periods at 125°C. Using the TES-C-110 cathode technology, cell voltages of 1.83 V at 450 ma/cm^2 and 100°C with negligible performance degradation was recorded for periods of over 1000 h. Ten alternative advanced cathodes and anodes were tested during the year. The best performance observed was from cells containing the recently available, inexpensive TES-C-AN cathodes and nickel screen anodes (1.73 V at 100°C, 450 ma/cm^2). This value represents a 17% voltage improvement and allowed H_2 production at 86.5% thermal efficiency. Testing of polybenzimidazole (PBI) separators in the 5-cell, 300 cm^2 test module was also initiated. Summaries of the electrolysis cell component testing is presented in this report as well as preliminary plans for work in GFY 1980.

18498 (CONF-791127—, pp 19-21) **Investigation of nickel whisker electrodes.** Moran, P.J.; Cahen, G.L.; Stoner, G.E. (Univ. of Virginia, Charlottesville). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

Improvement in the operating efficiency of alkaline water electrolyzers can be achieved by lowering the overpotentials for the hydrogen and oxygen evolution reactions. A relatively new technique for the preparation of high surface area nickel electrodes is the use of polycrystalline nickel whisker electrodes. These electrodes are characterized by high porosity and relatively high surface area. Research efforts have indicated that whisker electrodes represent approximately a 10% efficiency improvement over conventional Ni-200 screen electrodes on an apparent current density basis. Additional improvements can conceivably be obtained by optimization of whisker morphology, the addition of catalysts, and maximization of electrochemically active surface area.

18499 (CONF-791127—, pp 70-73) **Hydrogen production from small hydropower sites.** Wilkinson, E.L.; Kriebel, B.N.; Ramundo, K.J. (Air Products and Chemicals, Inc., Allentown, PA). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

In a US Department of Energy sponsored program, Air Products and Chemicals, Inc. (APCI) recently began studying the commercial feasibility of producing hydrogen with electrolytic cells powered by electricity generated from a small hydroelectric site. The conversion of hydro-power directly into hydrogen is being evaluated as a more promising mode of developing this energy resource than simply generating and transmitting electricity into the grid. The costs of connection, and the incongruency of the demand for and supply of the power to the grid frequently prohibits development in this manner. Since hydrogen can be stored to an extent, the conversion of hydro-power into hydrogen can mitigate these obstacles to small dam development. Whether utilized as a fuel in blending with natural gas or as a chemical feedstock (primarily produced by steam reformation of natural gas), hydrogen produced from small dams has the potential of reducing natural gas demand in the near and mid-term. The program also seeks to demonstrate the suitability of small dam (low-head) hydroelectric power for on-site industrial applications. The study will consist of three phases. The Systems Analysis phase will primarily involve an engineering and economic analysis of a typical 1.5 MW hydroelectric electrolytic hydrogen facility, including a sensitivity analysis of the major cost components of the delivered price of hydrogen as a chemical feedstock to establish site selection criteria. The purpose of the Site Selection phase is to select an actual site which will minimize the mix of fixed and variable costs of production and distribution. In the third phase, Site Engineering and Economics, a budget cost estimate for an actual facility complete with preliminary drawings will be prepared. Definitive estimates of power, hydrogen production, and distribution costs will be prepared. If the facility appears commercially viable, final engineering, construction, and operational phases would follow.

18500 (CONF-791127—, pp 74-76) **Hydropowered electrolysis in New York State.** Mathusa, P.D.; Wiley, R.A. (New York State Energy Research and Development Authority, Albany). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

An inventory of New York State's hydropower potential conducted by the New York State Energy Research and Development Authority has located more than 1000 sites with dams in the state which could be refurbished to produce power. It is estimated that these facilities can be made to generate 3.8 billion kWh of (firm) electrical power per annum. The present low rates which the utilities are willing to pay for excess dumped energy have motivated hydropower developers to find more lucrative means of utilizing excess power. Specifically, the Village of Potsdam has found that the use of excess power to operate an advanced technology solid polymer electrolyzer can produce research grade hydrogen whose kWh equivalent value is more than 10 times greater than that of dumped electrical energy. To achieve this goal, the Village's hydropower facility will be equipped with two 350-kW tube turbines and a 200-kW electrolyzer. The latter will produce approximately 18 million standard cubic feet of hydrogen annually which will be sold for $.50 per 100 ft^3.

18501 (CONF-791127—, pp 132-134) **Photoelectrochemical decomposition of water.** Rauh, R.D. (EIC Corp., Newton, MA). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

The goal of this program is to achieve efficient photoelectrochemical decomposition of H_2O with visible light. Research has entailed: (1) the synthesis and photoelectrochemical evaluation of ~ 150 n-doped semiconducting transition metal oxides; (2) assessment of the stability and photoelectrochemical properties of several p-type photocathodes; and (3) evaluation of several highly economical photoelectrochemical converters.

THERMOCHEMICAL PROCESSES

REFER ALSO TO CITATION(S) 18729, 19141

18502 (CONF-791127—, pp 89-92) **NASA hydrogen energy storage technology project.** Kelley, J.H. (California Inst. of Tech., Pasadena). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

A portion of the DOE/STOR Hydrogen Energy Storage Program has been conducted by NASA for DOE under an interagency agreement. That portion consists of research and development in the areas of advanced (solar) production concepts, thermochemical cycles, transmission and distribution, containment materials and associated system studies as well as the attendant project management. With the program budget decreasing 60% in FY80, this project is being phased out. The reported work is primarily from FY79, so the project is described for FY79.

18503 (CONF-791127—, pp 113-116) **Progress report on the development of the General Atomic thermochemical water-splitting cycle.** Besenbruch, G.E. (General Atomic Co., San Diego, CA); Norman, J.H.; McCorkle, K.H.; Rode, J.S.; Carrioglio, G.; Sharp, R.; Yoshimoto, M. Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

The major accomplishments of the DOE funded part of the total GA thermochemical water-splitting program are reported. They include: (1) incorporation of significant process improvements into the process; (2) development, review, and revision of an engineering flowsheet; (3) screening, identification, and testing of potential materials-of-construction for the corrosive process fluids; (4) increase of the process efficiency to ~ 47%; (5) small-scale demonstration of the cycle in a closed loop under recycle conditions; and (6) installation of the next phase of scale-up equipment (bench-scale) and demonstration of parts of the process in this equipment. The results of the work carried out during the last year have demonstrated that thermochemical water splitting by the sulfur-iodine cycle is a feasible process and have provided some confidence that thermal efficiencies as large as 50% are achievable.

18504 (CONF-791127—, pp 117-120) **Update on the sulfur cycle hydrogen production process.** Parker, G.H. (Westinghouse Advanced Energy Systems, Pittsburgh, PA). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

At last year's Contractor Review meeting, we highlighted progress through October 1978 on the development of the Sulfur Cycle. At that time, we had designed and were constructing a closed cycle working laboratory model. During November and December 1978, assembly of the model was completed, and initial testing occurred. This year, we have continued to use the model as a valuable development tool for the high temperature and electrolytic steps of the process. This report provides a brief update on the model and several other aspects of the Sulfur Cycle: sulfur dioxide electrolyzer development, high temperature materials evaluation, and catalyst testing for sulfur trioxide reduction.

BIOSYNTHESIS AND PHOTOCHEMICAL PROCESSES

REFER ALSO TO CITATION(S) 18603

18505 (CONF-791127—, pp 93-100) **Assessment of solar/hydrogen systems.** Escher, W.J.D. (Escher/Foster Tech. Associates, Inc., St. Johns, MI); Foster, R.W.; Hanson, J.A. Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

Solar energy represents a very large renewable energy resource which can, theoretically, be utilized in numerous ways to produce hydrogen from water. An initial assessment of solar/hydrogen systems is currently being completed. A large number of identified candidate production means have been characterized, from a technology standpoint, for both the direct and indirect solar energy conversion modes. Based on the status of the relevant technologies, and on the feasibility of production systems encompassing these technologies, a screening of the candidates capable of commercialization by the y 2000 is being carried out. One clear indication is that water electrolysis will play a key and unique role in such nearer-term applications. This paper reviews the context and coverage of the study and comments on the technologies assessed. (Details of the screening were not available for this paper.)

COAL GASIFICATION

18506 (CONF-791127—, pp 108-111) **Study of industrial hydrogen and syngas supply systems.** Amos, W.J.; Solomon, J. (Air Products and Chemicals, Inc., Allentown, PA). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

This study evaluates the potential and incentives required for supplying hydrogen and syngas ($2H_2$/1CO) feedstocks to the US chemical industry from coal gasification systems. Future hydrogen and syngas demand for chemical manufacture is estimated by geographic area. Projected economics for hydrogen and syngas manufacture are estimated with geographic area of manufacture and plant size as parameters. These estimates are made for natural gas, oil, and coal feedstocks. The economic estimates for coal technology involve different coal type, lignite and bituminous, and also atmospheric and elevated pressure gasification. Several problem areas presently affecting the commercial feasibility of coal gasification are considered in this study. The impact of potential process improvements are considered via the impact of hypothetical capital and operating cost improvements on hydrogen and syngas economics. Unique factors involved in financing coal gasification plants are discussed. Regulatory barriers are evaluated as they affect coal gasification. Coal mining/transportation, air quality regulations, and competitive feedstock pricing barriers are evaluated in summary fashion. Finally, the study discusses the potential for making coal gasification the least costly H_2 and syngas supply option. Options to stimulate coal gasification system development are discussed.

STORAGE

REFER ALSO TO CITATION(S) 18494, 18902

18507 (CONF-791127—, pp 39-42) **Development status of microcavity hydrogen storage systems for automotive applications.** Teitel, R.J. (Robert J. Teitel Associates, San Diego, CA). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

Robert J. Teitel Associates under sponsorship of the US Department of Energy is developing a new concept (microcavity storage) for hydrogen storage. The microcavity hydrogen storage concept proposes to use hollow glass microspheres for the storage of high pressure gas. Last year, the concept was detailed sufficiently to perform an engineering economic evaluation of the system and compare it to an equivalent metal hydride system. The microcavity storage system was lighter and more economical. However, the volume was larger. The study provided goals and a reference system for further engineering and experimental studies. An experimental program to evaluate two candidate commercially available microspheres for storage beds was initiated this year. Fillite grade 300/7 and 3M grade 32D/4500 were selected for the study. The Fillite grade proved to require a higher temperature source than available in automotive applications. The commercial grade 32D/4500 has more suitable properties. The only property that did not meet the target microsphere bed characteristic set by last year's study was the hydrogen storage medium weight density ($\sim$ 0.055 gmH_2/gm of bed). Two engineering studies were conducted this year. One was an engineering economic study of alternate concepts of a microsphere filling plant. The other was an engineering comparison of a hydrogen distribution system for the microcavity storage system to that for a metal hydride system.

CHEMISORPTION

18508 (BNL—27347) **Heat transfer enhancement in metal hydride systems.** Rosso, M.J. Jr.; Strickland, G. (Brookhaven National Lab., Upton, NY (USA)). Dec 1979. Contract EY-76-C-02-0016. 8p. (CONF-791204—27). Dep. NTIS, PC A02/MF A01.

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

The Brookhaven National Laboratory, Department of Energy and Environment has been engaged in finding solutions to the engineering problems associated with the storage of hydrogen as metal hydrides - principally iron-titanium hydride. The thermal conductivity in beds of fine particles, whatever their composition, is inherently poor. This paper reports on attempts to enhance the heat transfer by the addition of small fractions of high conductivity materials in various configurations. The results indicate that the form of the enhancement material rather than its composition is the more critical factor.

18509 (CONF-791127—, pp 26-30) **Hydride beds: engineering tests.** Rosso, M.J. Jr.; Strickland, G. (Brookhaven National Lab., Upton, NY). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

The BNL Hydrogen Storage Program engineering effort is directed toward finding solutions to the engineering problems associated with metal hydrides - principally FeTiH/sub x/. Measurements of thermal conductivity in non-enhanced, copper mesh-enhanced and aluminum foam-enhanced hydride beds have been made and indicate that the form of the enhancement material is the critical factor. The completion of the HYTACTS and its initial shakedown runs suggest the many applications for this new facility in the area of advanced hydrogen component testing. The performance testing of the Variable Parameter Test Unit-2 (VPTU-2) will begin following the BNL Safety Committee approval. A description of this vessel is included. The purpose, description and status of the Variable Parameter Test Unit-1 (VPTU-1) is reported as well as the results of the first set of tests performed in this vessel.

18510 (CONF-791127—, pp 31-33) **Modeling solid hydrogen storage beds.** Fisher, P.W.; Watson, J.S. (Oak Ridge National Lab., TN). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

Computer programs are being developed to predict the performance of hydrogen storage beds from the physical and chemical properties of the hydrogen storage material, the geometry of the bed, and the desired operational characteristics of the bed. The data base for these programs contains the properties of iron-titanium (FeTi) alloy, but the base could be extended to include properties of any material. Predictions have been made for two different shell-and-tube geometries in which the storage material is either in the shell or in the tubes. The programs predict bed pressure and temperature profiles as a function of flow rate, or flow rate as a function of pressure. Bed dimensions, temperature of heat transfer fluid, and heat transfer coefficient are parameters. The mathematical models that are being developed for these programs are evaluated by comparing predicted results with experimental data supplied by Brookhaven National Laboratory. A model that assumes rapid kinetics (equilibrium) and contains no empirical parameters produces bed pressures and temperatures which are in good qualitative agreement with experimental data; however, events such as maximum (or minimum) pressure and center-line temperature are predicted to occur at times different from those observed. An example of these results is presented here.

18511 (CONF-791127—, pp 56-60) **Development of new hydrogen storage systems for automotive hydrogen fuel storage.** Eisenberg, F.G.; Sheridan, J.J. III; Zagnoli, D.A. (Air Products and Chemicals, Inc., Allentown, PA). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

Mg_5Al_8 has been identified on the basis of thermodynamic considerations as a good candidate for automotive hydrogen fuel storage. The kinetics of the alloy/hydrogen reaction are poor, however, and the objectives of this study were to define the products of reaction and study the effect Ni has upon the rate of reaction. To accomplish the first objective, reacted and unreacted alloy samples were characterized by x-ray diffraction. Results indicated that the reacted alloy had rearranged to form pockets of MgH_2 and Al rather than the ternary hydride. The second objective, Ni catalysis of the alloy, was studied by incorporating Ni as a powder, plating, and alloy with fine particles size Mg_5Al_8. The Ni is ineffectual in increasing the rate of absorption, but enhances the rate of desorption. Furthermore, there is evidence that surface morphology and particle size, as well as a method of Ni incorporation, are important to the kinetics. It is concluded that further work is necessary to clarify the individual effect each of these factors has on the kinetics.

18512 (CONF-791127—, pp 61-63) **Development of hydrogen storage materials for application to energy needs.** Lundin, C.E.; Liu, J.; Magee, C.B. (Univ. of Denver, CO). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

The hydriding characteristics of many selected alloy combinations have been systematically investigated. Accurate pressure-temperature-composition relationships of the selected alloy systems were determined. The objectives of this program were to extend the number of hydrides useful for hydrogen storage, and to increase their storage capacities. The goal to develop a hydride with a capacity of at least three weight percent hydrogen has been arbitrarily established. Several alloy compositions in the Ti-V-Mn system are able to hydride to a capacity of over three weight percent hydrogen. Other alloys with the structure types: $CrB(B_1)$, $SnNi_3(D0_{19})$, $TiAl_3(D0_{22})$, $AuCu_3(L1_2)$, $BaAl_4(D1_3)$, ThB_4(D1/sub e/), $CaCu_5$(D2/sub d/), AlB_2(C32) and $MgCu_2$(C15), as well as the Ti-V-Mn system and Ti-V-Cr system were screened. Since there are no ternary phase diagrams available for the Ti-V-Mn and Ti-V-Cr systems, in order to design alloys with possible single phases in those systems, phase equilibrium had to be predicted from projections of the related binary systems. Geometric investigations of the CrB(Bf) type structure were made. The intermetallic compound LaNi was chosen for analysis. The sizes and relative positions of tetrahedral holes in this type of intermetallic compound were considered in detail. There are different types of holes in this structure than were found in the more symmetric structures studied previously. Individual holes and clusters of holes favorable for hydrogen occupancy were identified, and maximum hydrogen concentration, in solid

solution, in this type of compound was predicted. These predictions compare favorably with the very limited amount of experimental data available for the hydriding behavior of these compounds.

18513 (CONF-791127—, pp 64-67) **Surface poisoning of metal hydrides.** Goodell, P.D.; Sandrock, G.D. (Inco Research and Development Center, Suffern, NY). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

This report is a brief summary of an extensive experimental program designed to understand the surface poisoning of metal hydrides by impurities in the hydrogen used. Alloys investigated were $LaNi_5$, FeTi, and $Fe_{0.85}Mn_{0.15}Ti$. Gaseous impurities studied were O_2, H_2O, and CO. The nature of the surface structures formed, and consequently the degree of poisoning, varies markedly from alloy to alloy and from impurity to impurity. Examples of complex compound film formation, chemisorption, and possibly physisorption can be seen. Results show the hope of developing surface structures with significant resistance to impurity gases and especially the possibility of designing practical regeneration cycles.

18514 (CONF-791127—, pp 101-107) **Solar hydrogen production via the sulfur/iodine thermochemical water-splitting cycle.** Schuster, J.R.; Besenbruch, G.E.; Chiger, H.D.; McCorkle, K.H. (General Atomic Co., San Diego, CA). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

A study is being conducted to examine the requirements for producing hydrogen by driving the sulfur/iodine thermochemical water-splitting cycle using solar energy. The process configuration involves conducting the high temperature portion of the cycle (sulfuric acid decomposition) during daylight and storing sufficient SO_2 and O_2 to provide enough recycle materials to run the other portions of the cycle continuously. Various types of solar collectors have been evaluated for supplying heat for sulfuric acid decomposition. Cavity-type and fluidized bed-type tower central receivers are preferred. A comparison of molten salt sensible heat storage and additional SO_2/O_2 storage is in progress to determine the preferred energy storage method for driving the lower temperature portions of the process at night. Early indications are that the molten salt storage will be the preferred approach.

UNDERGROUND

18515 (CONF-791127—, pp 43-47) **Underground storage of hydrogen.** Foh, S.M.; Novil, M.; Randolph, P.L.; Rockar, E.M. (Institute of Gas Technology, Chicago, IL). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

An extensive study of the technical and economic feasibility of storing hydrogen gas in underground reservoirs is briefly summarized. A depleted field, an aquifer, a salt cavern, and an excavated rock cavern were studied. The only major technical limitation is that of hydrogen embrittlement, which at the present time restricts reservoir pressures to 1200 psi or less. An economic methodology was developed to predict the cost of service for hydrogen storage. This methodology was verified and tested on natural gas storage. Costs of service ranged from 26% to 150% of the cost of the gas stored.

CRYOGENIC

REFER ALSO TO CITATION(S) 18502

TRANSPORT

REFER ALSO TO CITATION(S) 18502

18516 (CONF-791127—, pp 48-51) **Design, construction, and testing of a thermally activated hydrogen chemical compressor.** Snape, E. (MPD Technology Corp., Wyckoff, NJ); Lynch, F.E. Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

With support from the US Department of Energy and its subcontractor, Denver Research Institute, Ergenics is developing a metal hydride compressor which is expected to improve the overall economics of hydrogen production and handling. Several critical modelling experiments have been performed and a compressor design selected. Construction of the compressor is in progress and testing and evaluation are expected to be completed within six months. Progress to date and work plans for completion of Phase I of this project are summarized.

18517 (CONF-791127—, pp 150-154) **Hydrogen compatibility of structural materials for energy storage and transmission.** Hoover, W.R.; Iannucci, J.J.; Spingarn, J.R.; Robinson, S.L.; Stoltz, R.E. (Sandia Labs., Livermore, CA). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

The primary objective of this program is to assess the feasibility of transporting large quantities of gaseous hydrogen through the existing natural gas pipeline network. The hydrogen compatibility of these pipeline steels and their weldments is being assessed by conducting experiments in three major areas: (1) in our experimental pipeline loop, we are evaluating the performance of flawed pipeline segments in flowing 1000 psig hydrogen gas; (2) the degradation of pipeline steel fracture toughness is being studied in high pressure hydrogen using J-integral techniques; and (3) the hydrogen compatibility of pipeline weldments is being investigated to determine if any of the metallurgical microstructures produced by welding are particularly susceptible to hydrogen embrittlement. In addition to the main activities on this program, we have been requested to conduct two systems studies evaluating the optimum storage techniques and locations for fixed-site storage of hydrogen fuel. Contributions and accomplishments during FY 1979 are summarized.

INDUSTRIAL AND COMMERCIAL USE

REFER ALSO TO CITATION(S) 18502, 18506

PROPERTIES

REFER ALSO TO CITATION(S) 18517, 19142

18518 (CONF-791127—, pp 167-171) **Influences of stress state on hydrogen embrittlement.** Louthan, M.R. Jr.; McNitt, R.P.; Adler, T.A.; Murali, J.; Smith, P.E. (Virginia Polytechnic Inst. and State Univ., Blacksburg). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

Experimental hydrogen embrittlement studies of A-106 and 4340 steels have shown that hydrogen increases the ease of crack propagation in both alloys. Delayed failure tests with 4340 steel samples have demonstrated that the onset of hydrogen embrittlement is quite sensitive to macroscopic stress state and specimen thickness. The thickness effect is rationalized in terms of the need for a critical stress existing to a microstructurally significant depth in the loaded sample. No delayed failure was observed in A-106 steel samples; however, crack initiation and growth studies have shown that the crack path is primarily macroscopically perpendicular to the maximum normal stress, primarily transgranular although not planar within each ferrite grain. No strong dependence on triaxial stresses is required and crack initiation sites are typically surface flaws or internal defects such as inclusions and stringers. Plastic deformation is an apparent precursor to hydrogen induced crack growth in these steels. These observations imply that the susceptibility of steels to hydrogen embrittlement can be minimized by proper design criteria.

18519 (CONF-791127—, pp 172-175) **Near-threshold fatigue crack propagation in pipeline steels in high pressure environments.** Mitchell, M.R. (Rockwell International Science Center, Thousand Oaks, CA); Paton, N.E.; Ritchie, R.O.; Nguyen, N.Q. Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

The use of hydrogen for energy storage and transport holds particular promise as a significant option for energy transportation in the not too far distant future. To meet this need, large-scale gas pipeline systems will be required to transport hydrogen and combinations of hydrogen and other gases, such as natural gas, under high pressure conditions. Since such pipeline systems must contain in-line compressors, possible sub-critical crack growth of incipient flaws under cyclic loading conditions offers a potential problem. Existing information on fatigue crack growth in pipeline steels under representative environmental conditions is scarce and limited to intermediate and high growth rate ($\sim 10^{-5}$ mm/cycle) data. It is the purpose of this research to generate fatigue crack propagation data in a typical pipeline steel under anticipated high pressure environments over a wide range of growth rates including low crack growth rates (10^{-5} mm/cycle) which approach the threshold for fatigue crack growth ($\Delta K/sub\ th/$).

18520 (CONF-791127—, pp 176-177) **Hydrogen and fatigue properties of steel.** Johnson, H.H. (Cornell Univ., Ithaca, NY). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

A major area of uncertainty in the application of carbon and low alloy steel in hydrogen containing gas environments is cyclic loading and consequent fatigue damage. The present program, just underway, is intended to greatly strengthen the knowledge base for the influence of hydrogen upon fatigue properties, with emphasis

upon the factors controlling the initiation of fatigue cracks in hydrogen gas environments.

OTHER SYNTHETIC AND NATURAL FUELS

PREPARATION

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 18329

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 18593, 18596

18521 (PB—296363) **Conversion of feedlot wastes into pipeline gas.** Varani, F.T.; Burford, J.J. Jr. (Bio-Gas of Colorado, Inc., Arvada (USA)). 1979. 24p. NTIS, PC A02/MF A01.

Agriculture waste material such as steer manure has an energy value which ranges from 3000-8000 BTU per pound of solid material. This material is currently being used, almost exclusively, in its traditional manner as an addition to agricultural croplands. This study concludes that there is a commercially viable energy potential from agricultural waste conversion using an anaerobic digestion system.

18522 (PB—296444) **Energy potential through bio-conversion of agricultural wastes.** (Bio-Gas of Colorado, Inc., Arvada (USA); Colorado Energy Research Inst., Golden (USA)). Oct 1976. Contract FCRC-651366075. 32p. NTIS, PC A03/MF A01.

To determine the feasibility of using the bio-conversion process, the Bio-Gas study team examined factors ranging from an inventory of readily collectable agricultural wastes in the area to an evaluation of the potential markets for the products of bio-conversion. The results of this study point favorably toward large-scale bio-conversion plants and to potential applications of bio-conversion on a small sc ? for dairies and feedlots. The study's economic analysis concludes that the methane produced from such a bio-conversion facility would be cheaper than all other domestic synthetic natural-gas sources. The residue produced from this process could be marketed as fertilizer, and the algae produced has potential use as a high-protein cattle feed.

18523 (PB—296542) **Methane on the move, a discussion of small anaerobic digesters. Final report.** Schellenbach, S.; Turnacliff, W.; Varani, F.; Burford, J.L. Jr; Don, S.B. (Colorado Energy Research Inst., Golden (USA); Bio-Gas of Colorado, Inc., Loveland (USA)). Mar 1977. Contract FCRC-651366075. 101p. NTIS, PC A06/MF A01.

This report is a discussion of small anaerobic digestion units, stimulated by experiments operated by Bio-Gas of Colorado. A grant from the Four Corners Regional Commission to the Colorado Energy Research Institute enabled Bio-Gas to build a 12 to 50 cow digestion unit on a trailer which could be pulled by a tractor to 19 different demonstration sites in Colorado, New Mexico, Arizona, Utah and Nevada. During this same period, Bio-Gas conducted laboratory experiments to determine yield coefficients of different manures and defined parameters to evaluate the economic feasibility of building digesters on a small or self-sufficiency scale. First the report describes the mobile digestion unit of 6,000 gallons with its start-up phases, operation, production and problems. Secondly, a discussion of the tour and a summary of the Journal in the Appendix tell how the digester performed and how it was received among the people who came to see the demonstration. Finally, the report includes designs for four different sizes of digesters based on data collected from the mobile unit, the tour and the laboratory, along with an order blank for shop drawings. A series of design tables which let interested persons easily size a digestion system and tailor it to their specific needs are included. The tables estimate gas production from a variety of manures and system sizes so the economics of the system can be studied.

18524 (PETC/TR—79/4) **Hydrogenation of organic solid wastes.** Wu, W.R.K.; Kawa, W. (Department of Energy, Pittsburgh, PA (USA). Pittsburgh Energy Technology Center). Feb 1980. 46p. Dep. NTIS, PC A03/MF A01.

Eight organic solid wastes, six cellulosic and two noncellulosic, were hydrogenated batchwise with and without a catalyst. Conversions obtained range from 64 to 98 % of moisture- and ash-free (maf) raw material; oil yields, 10 to 59 %; and gaseous hydrocarbon yields, 7 to 16 %. Based on batch hydrogenation results, the oil production from large-scale hydrogenation of the wastes is projected to be 1.6 to 3.5 bbl/ton of maf raw material; the gaseous-hydrocarbon production, 2000 to 4100 standard cubic feet (scf). Activities of the two catalysts ($SnCl_2$/ and a combination of Fe_2O_3 and H_2S) used in the hydrogenation of the wastes are discussed. Also discussed are the chemical reactions and mechanisms involved in the hydrogenation, potential market for the product oil, and possible improvement of the oil yield. Elemental compositions of the hydrogenation oils and types of hydrocarbons including oxygenated hydrocarbons found in the oils are presented. The energy equivalent of the organic solid wastes generated in the United States in 1973 is shown to be 27 % of the nation's total 1972 energy production.

18525 (SAN—2165-1) **Energy from marine biomass. Final report.** Tompkins, A.N. (General Electric Co., Philadelphia, PA (USA). Re-Entry and Environmental Systems Div.). 20 Mar 1979. Contract ET-78-F-03-2165. 245p. Dep. NTIS, PC A11/MF A01.

The fabrication, assembly and successful deployment of the first open ocean, deep water Biological Test Farm related to the continuing search for alternative energy sources are discussed. This Farm is dedicated to the study of the growth and nutrition of Macrocystis pyrifera (Giant California Kelp) with the far reaching goal of commercializing an ocean grown biomass feedstock for production of substitute natural gas (SNG). The innovative fabrication and vertical deployment of a 1500 foot long, 24 inch diameter flexible pipe for the upwelling of nutrient rich bottom water to the Test Farm was completed. Efforts to develop an optimized marine derived anaerobic culture for the conversion of kelp to methane gas were continued. The successes of this research during 1978 continue to hold promise of maximizing the anaerobic conversion/methane generation process to the theoretical yield limits using marine strains compatible with kelp in the aquatic habitat and with the attendant environmental constraints of the digester. To this end, this research has shown that high salt concentrations, up to 7% can be accomodated, ambient temperature digestion can proceed with no apparent loss in gas production as opposed to the classic mesophilic (37° C) process, and the key help constituents, mannitol and algin, are completely utilizable and theoretically convertible to methane. A Gas Cost Analysis was conducted in 1978 as part of the on-going Systems Requirements and Economic Analysis task. This task is designed as a key program tool for coordinating and guiding the experimental and analytical work performed on the Marine Biomass Program. The first-order results of the Gas Cost Analysis indicate that the Marine Biomass SNG costs will be competitive with other SNG sources falling in the range of $3 to 56 per million BTU. The cost could even be less when credits for by-products, such as fertilizer or co-products such as fish and shellfish are included.

18526 (PB—297371) **Methane generation by anaerobic fermentation; an annotated bibliography.** Freeman, C.; Pyle, L. (Intermediate Technology Development Group, London (UK)). [nd]. 71p. Microfiche copies only.

This bibliography is for those who are directly involved or interested in building, designing, and improving methane generators in the developing countries. It includes the basic and relevant material required to enable those working in this field to decide on the viability of gas production and to help them learn from other people's experience.

PROPERTIES

REFER ALSO TO CITATION(S) 19127

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 18595, 18596, 18597

SOLID WASTE FUELS

REFER ALSO TO CITATION(S) 18598

18527 (EPRI-FP—1249) **Prediction of the impact of screening on refuse-derived fuel quality. Final report.** Trezek, G.J.; Diaz, L.F.; Savage, G.M.; White, R. (Cal Recovery Systems, Inc., Richmond, CA (USA); Midwest Research Inst., Kansas City, MO (USA)). Nov 1979. 79p. Dep. NTIS, PC A^5/MF A01.

This study investigates systems used to recover refuse derived fuel (RDF) from municipal solid waste and the means of predicting and evluating performance of these systems. In addition to detailed analysis of two resource recovery systems, modeling techniques were employed to predict system performance for different processing options and operating conditions. Models were developed for four unit processes: (1) size reduction, (2) air classification, (3) magnetic separation, and (59 pre-trommeling. Results of the analysis show that screening of either raw refuse or the product air classified light fraction improves the combustion properties of the RDF by reducing the ash, glass and moisture contents.

18528 (RLO—2227-T22-14) **Combustion characteristics of six types of wood residue fuels as used in industrial spreader-stoker boilers. Technical progress report No. 10, September 16, 1977-September 15, 1978.** Junge, D.C. (Oregon State Univ., Corvallis (USA)). Feb 1979. Contract EY-76-S-06-2227-022. 54p. Dep. NTIS, PC A04/MF A01.

In April 1976, the Energy Research and Development Administration (ERDA) funded a research project entitled Investigation of the Rate of Combustion of Wood Residue Fuels. In Fiscal 1978, the US Dept. of Energy provided continuation funding for this project. A pilot scale wood combustion test facility was constructed under the project and has been used to collect data on the combustion characteristics of wood residue fuels under a variety of operating conditions. The detailed results of these experiments are reported in other Technical Progress Reports. This Technical Progress Report is an executive summary of the experimental results obtained in Fiscal 1978 under the DOE funding. It provides information concerning the effects on the combustion process of the following variables: (1) fuel size; (2) fuel moisture levels; (3) fuel feed rate; (4) fuel species; (5) combustion air temperature; (6) air to fuel ratio at the grate; (7) level of excess air; and (8) distribution of combustion air above and below the grate. A summary of the experimental results is included in the report.

18529 (RLO—2227-T22-18) **Combustion characteristics of whole tree hardwood chips from Raleigh, North Carolina. Technical progress report No. 11, September 16, 1978-September 15, 1979.** Junge, D.C. (Oregon State Univ., Corvallis (USA)). Sep 1979. Contract EY-76-S-06-2227-022. 96p. Dep. NTIS, PC A05/MF A01.

Significant quantities of wood residue fuels are presently being used in industrial steam generating facilities. Recent studies indicate that substantial additional quantities of wood residue fuels are available for energy generation in the form of steam and/or electricity. A limited data base on the combustion characteristics of wood residue fuels has resulted in the installation and operation of inefficient combustion systems for these fuels. This investigation of the combustion characteristics of wood residue fuels was undertaken to provide a data base which could be used to optimize the combustion of such fuels. Optimization of the combustion process in industrial boilers serves to improve combustion efficiency and to reduce air pollutant emissions generated in the combustion process. This report presents data on the combustion characteristics of Whole Tree Hardwood Chips from Raleigh, North Carolina. The data were obtained in a pilot scale combustion test facility at Oregon State University.

18530 (RLO—2227-T22-19) **Combustion characteristics of pelletized Douglas Fir bark. Technical progress report No. 12, September 16, 1978-September 15, 1979.** Junge, D.C. (Oregon State Univ., Corvallis (USA)). Sep 1979. Contract EY-76-S-06-2227-022. 140p. Dep. NTIS, PC A07/MF A01.

Significant quantities of wood residue fuels are presently being used in industrial steam generating facilities. Recent studies indicate that substantial additional quantities of wood residue fuels are available for energy generation in the form of steam and/or electricity. A limited data base on the combustion characteristics of wood residue fuels has resulted in the installation and operation of inefficient combustion systems for these fuels. This investigation of the combustion characteristics of wood residue fuels was undertaken to provide a data base which could be used to optimize the combustion of such fuels. Optimization of the combustion process in industrial boilers serves to improve combustion efficiency and to reduce air pollutant emissions generated in the combustion process. This report presents data on the combustion characteristics of Pelletized Douglas Fir Bark. The data were obtained in a pilot scale combustion test facility at Oregon State University. Other technical reports present data on the combustion characteristics of: Douglas Fir Bark, Douglas Fir Planer Shavings; Red Alder Sawdust, Red Alder Bark, Hemlock Bark, Ponderosa Pine Bark, Eastern White Pine Bark from New Hampshire, Whole Tree Hardwood Chips from North Carolina, Pelletized Ponderosa Pine Wood, White Fir Bark, Lodge Pole Pine Bark, and Mixed Hardwood Bark from Wisconsin.

18531 (RLO—2227-T22-20) **Combustion characteristics of pelletized Ponderosa Pine wood. Technical progress report No. 13, September 16, 1978-September 15, 1979.** Junge, D.C. (Oregon State Univ., Corvallis (USA)). Sep 1979. Contract EY-76-S-06-2227-022. 103p. Dep. NTIS, PC A06/MF A01.

Significant quantities of wood residue fuels are presently being used in industrial steam generating facilities. Recent studies indicate that substantial additional quantities of wood residue fuels are available for energy generation in the form of steam and/or electricity. A limited data base on the combustion characteristics of wood residue fuels has resulted in the installation and operation of inefficient combustion systems for these fuels. This investigation of the combustion characteristics of wood residue fuels was undertaken to provide a data base which could be used to optimize the combustion of such fuels. Optimization of the combustion process in industrial boilers serves to improve combustion efficiency and to reduce air pollutant emissions generated in the combustion process. This report presents data on the combustion characteristics of pelletized Ponderosa Pine wood. The data were obtained in a pilot scale combustion test facility at Oregon State University.

18532 (RLO—2227-T22-21) **Combustion characteristics of White Fir Bark. Technical progress report No. 14, September 16, 1978-September 15, 1979.** Junge, D.C. (Oregon State Univ., Corvallis (USA)). Sep 1979. Contract EY-76-S-06-2227-022. 117p. Dep. NTIS, PC A06/MF A01.

Significant quantities of wood residue fuels are presently being used in industrial steam generating facilities. Recent studies indicate that substantial additional quantities of wood residue fuels are available for energy generation in the form of steam and/or electricity. A limited data base on the combustion characteristics of wood residue fuels has resulted in the installation and operation of inefficient combustion systems for these fuels. This investigation of the combustion characteristics of wood residue fuels was undertaken to provide a data base which could be used to optimize the combustion of such fuels. Optimization of the combustion process in industrial boilers serves to improve combustion efficiency and to reduce air pollutant emissions generated in the combustion process. This report presents data on the combustion characteristics of white fir bark. The data were obtained in a pilot scale combustion test facility at Oregon State University.

18533 (RLO—2227-T22-22) **Combustion characteristics of lodge pole pine wood chips. Technical progress report No. 15, September 16, 1978-September 15, 1979.** Junge, D.C. (Oregon State Univ., Corvallis (USA)). Sep 1979. Contract EY-76-S-06-2227-022. 82p. Dep. NTIS, PC A05/MF A01.

Significant quantits of wood resiue fuels are presently being used in industrial steam generating facilities. Recent studies indicate that substantial additional quantities of wood residue fuels are available for energy generation in the form of steam and/or electricity. A limited data base on the combustion characteristics of wood residue fuels has resulted in the installation and operation of inefficient combustion systems for these fuels. This investigation of the combustion characteristics of wood residue fuels was undertaken to provide a data base which could be used to optimize the combustion of such fuels. Optimization of the combustion process in industrial boilers serves to improve combustion efficiency and to reduce air pollutant emissions generated in the combustion process. This report presents data on the combustion characteristics of lodge pole pine wood chips. The data were obtained in a pilot scale combustion test facility at Oregon State University.

18534 (RLO—2227-T22-23) **Preliminary interim test report: Oregon State University - Weyerhaeuser experiments, Oregon State University wood combustion test facility. Technical progress report No. 16, September 16, 1978-September 15, 1979.** Tuttle, K.L.; Junge, D.C. (Weyerhaeuser Co., Tacoma, WA (USA); Oregon State Univ., Corvallis (USA)). Sep 1979. Contract EY-76-S-06-2227-022. 474p. Dep. NTIS, PC A20/MF A01.

Weyerhaeuser Company contracted to modify the Oregon State University experimental combustor during June and July 1978 to facilitate the combustion testing proposed by the Test Plan (included as Appendix E) for August and September 1978. The tests were a joint effort between OSU and Weyerhaeuser, with the results being reported to OSU in an Interim Report to expedite transfer of data and a final report to complete the transfer of analytical results. The objectives of the tests are stated as follows: (1) determine how much the underfire air/fuel ratio and excess air levels interact with fuel fluctuations; (2) determine whether/how much fuel mixing, sizing, or segregation would affect furnace combustion efficiency and stack emissions; and (3) determine whether/how much fluctuations in fuel feed rate affect combustion efficiency and stack emissions. Preliminary results allow conclusions as follows: (1) The underfire air/fuel ratio and excess air levels interact with fuel fluctuations to a small degree. The effect of step-changes in combustion rate appear to be reduced by decreasing underfire air rate. Excess air appears to decrease the effects of step-changes in combustion rate as excess air is decreased. (2) Fuel mixing, sizing, or segregation could affect furnace combustion efficiency and stack emissions. Abrupt changes from wetter fuel to dryer fuel appears to generate increased particulate emissions. Increased emissions as high as 25 percent may last for several minutes during intense combustion of excess fuel banked for drying by the wetter fuel. However, increases in particulate emissions during fluctuations in fuel conditions tend to be nullified by decreases in emissions during opposing fluctuations.

POWER CONVERSION SYSTEMS

REFER ALSO TO CITATION(S) 18803

SOLAR ENERGY

REFER ALSO TO CITATION(S) 19090

18535 (CONF-781235—P1, pp 211-212) **Present status of solar energy technology in Spain.** Nieto, J. (Solar Energy Commission, Barcelona, Spain). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18536 (CONF-781235—P2) **Solar energy and conservation symposium-workshop. Workshop reports.** (Miami Univ., Coral Gables, FL (USA). Clean Energy Research Inst.). 1978. Contract AC01-79CS30014. 32p. Dep. NTIS, PC A03/MF A01.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

The findings of workshops held on (1) solar collectors, (2) solar heating and cooling, (3) solar power production, (4) conservation, and (5) commercialization and technology transfer are summarized. (WHK)

RESOURCES AND AVAILABILITY

REFER ALSO TO CITATION(S) 18555, 19287

18537 (CONF-781235—P1, pp 165-166) **Reductions in solar radiation and solar flux over urbanized areas and the consequences to solar and conservation technologies.** Robbins, C.L. (Florida A and M Univ., Tallahassee). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18538 (CONF-781235—P1, pp 225-227) **Uses of solar energy in Iraq.** Hussain, I.M. (Univ. of Baghdad, Iraq). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18539 (DOE/CS/32939—9) **Model for the angular distribution of sky radiance.** Hooper, F.C.; Brunger, A.P. (Toronto Univ., Ontario (Canada). Dept. of Mechanical Engineering). Aug 1979. Contract EY-76-C-02-2939. 7p. (CONF-790808—23). Dep. NTIS, PC A02/MF A01.

From 18. ASME national heat transfer conference; San Diego, CA, USA (Aug 1979).

A flexible mathematical model is introduced which describes the radiance of the dome of the sky under various conditions. This three-component continuous distribution (TCCD) model is compounded by the superposition of three separate terms, the isotropic, circumsolar and horizon brightening terms, each representing the contribution of a particular sky characteristic. In use a particular sky condition is characterized by the values of the coefficients of each of these three terms, defining the distribution of the total diffuse component. The TCCD model has been demonstrated to fit both the normalized clear sky data and the normalized overcast sky data with an RMS error of about ten percent of the man overall sky radiance. By extension the model could describe variable or partly clouded sky conditions. The model can aid in improving the prediction of solar collector performance.

ECONOMICS

REFER ALSO TO CITATION(S) 18551, 18615, 18625, 18649, 18652, 18662

18540 (CONF-781235—P1, pp 113) **International solar markets.** Gerlach, K.A.; Meagher. P. (SRI International, Menlo Park, CA). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18541 (DSE—4230-T1(Vol.1)) **Study of capital requirements for solar energy. Final report, Volume 1. Analysis of the macroeconomic effects of increased solar energy market penetration.** Pleatsikas, C.J.; Hudson, E.A.; O'Connor, D.C.; Funkhouser, D.H. (Urban Systems Research and Engineering, Inc., Cambridge, MA (USA); Jorgenson (Dale W.) Associates, Cambridge, MA (USA)). 19 Jul 1979. Contract EM-78-C-01-4230. 197p. Dep. NTIS, PC A09/MF A01.

This report defines the analytical framework for, and presents the results of, a study to determine the macroeconomic effects of increased market penetration of solar energy technologies over the 1977-2000 time period. For the purposes of this document, solar technologies are defined as wind, photovoltaics, ocean thermal electric (OTEC), small-scale (non-utility) hydroelectric and all solar active and passive thermal technologies. This research has been undertaken in support of the National Plan to Accelerate Commercialization (NPAC) of Solar Energy. The capital and operating requirements for three market penetration levels are first determined; the effects of these requirements on economic performance are then estimated using the Hudson-Jorgenson Energy/Economic Model. The analytical design, computational methods, data sources, assumptions and scenario configurations for this analysis are defined in detail. The results of the analysis of the economic impact of solar energy are presented in detail, and the implications of these results are discussed. Appendix A explains the methodology for transforming investment to capital stocks. Appendix B, which is provided in a separate volume, describes the Hudson-Jorgenson Model in greater detail. (WHK)

18542 (DSE—4230-T1(Vol.2)) **Study of capital requirements for solar energy. Final report, Volume 2. Appendix B: The Hudson-Jorgenson energy/economic model (Long-term interindustry transactions model): a description.** Hudson, E.A.; Jorgenson, D.W. (Urban Systems Research and Engineering, Inc., Cambridge, MA (USA); Jorgenson (Dale W.) Associates, Cambridge, MA (USA)). 19 Jul 1979. Contract EM-78-C-01-4230. 81p. Dep. NTIS, PC A05/MF A01.

The Hudson-Jorgenson Energy/Economic Model - formally known as the Long Term Interindustry Transactions Model (LITM) - is an econometric model of the structure of the US economy. LITM integrates two separate models into one integrated system. These models are the Macroeconomic Model, a growth model incorporating the underlying trends of economic development, and the Interindustry Model, an endogenous coefficient input-output model of the structure of the economy incorporating patterns of expenditure, prices, and production on a sectoral basis. LITM emphasizes the energy system and its role within the economy. Applications of LITM have, therefore, focused on energy, the effect of energy changes on the economy, and the effect of econometric changes on the energy system. In addition, LITM can be used as framework for long term economic projection and structural analysis.

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 18560, 18621, 18639, 18794

18543 (CONF-781235—P1, pp 65-66) **Commercialization of solar systems through standards, evaluation, inspection and redress: a joint effort.** Hunt, D.F.; Mueller, W.K.; Thorsen, R.S. (Polytechnic Inst. of New York, Brooklyn). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18544 (CONF-781235—P1, pp 71) **Solar commitment, deferral and dropout in the state of Connecticut.** Warkov, S. (Univ. of Connecticut, Storrs). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18545 (CONF-781235—P1, pp 83-85) **Sources of capital for solar electric technologies.** Hurwood, D.L. (Energy Economics and Alternatives, New York, NY). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18546 (CONF-781235—P1, pp 149-150) **Solar commercialization plans and program: an international action.** Lutkefedder, N.W. (Dept. of Energy, Washington, DC). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18547 (CONF-781235—P1, pp 151-153) **Standards and solar energy commercialization.** Riley, J.D.; Odland, R.; Barker, H. (Solar Energy Research Inst., Golden, CO). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18548 (CONF-781235—P1, pp 155-156) **Commercialization of solar technologies: how are criteria established to protect the consumer from fraudulent products.** Slaby, S.M. (Princeton Univ., NJ); Fedors, J. Jr. 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18549 (CONF-781235—P1, pp 157-159) **Modeling the environmental impacts of solar energy technologies.** Yokell, M.D. (Solar Energy Research Inst., Golden, CO). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18550 (CONF-781235—P1, pp 161-163) **Elite management vs self-reliance: policy alternatives for solar and conservation energy programs.** Worthington, R.K. (Rensselaer Polytechnic Inst., Troy, NY). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18551 (CONF-781235—P1, pp 167) **Solar development and urban fiscal policy: a possible confrontation.** Robbins, C.L. (Florida A and M Univ., Tallahassee). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18552 (CONF-781235—P1, pp 275-276) **Commercialization problems of solar design.** Franta, G. (Solar Energy Research Inst., Golden, CO). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18553 (CONF-781235—P1, pp 277-279) **Technology transfer: technical outreach programs in the northeast.** Brown, S.M. (Northeast Solar Energy Center, Cambridge, MA). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18554 (CONF-781235—P1, pp 343-345) **Assessment of the consumer problem in solar energy.** Yarosh, M.; Talwar, R.; Sim, S.; Litka, A. (Florida Solar Energy Center, Cape Canaveral). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18555 (CONF-781235—P1, pp 347-348) **Solar energy and New Jersey.** Vehrkens, K.T. (Fairleigh Dickinson Univ., Hackensack, NJ). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18556 (DOE/ER—0036/2) **Preliminary environmental assessment for the Satellite Power System (SPS). Revision 1. Volume 2. Detailed assessment.** (Department of Energy, Washington, DC (USA). Office of Energy Research). Jan 1980. 205p. Dep. NTIS, PC A10/MF A01.

The Department of Energy (DOE) is considering several options for generating electrical power to meet future energy needs. The satellite power system (SPS), one of these options, would collect solar energy through a system of satellites in space and transfer this energy to earth. A reference system has been described that would convert the energy to microwaves and transmit the microwave energy via directive antennas to large receiving/rectifying antennas (rectennas) located on the earth. At the rectennas, the microwave energy would be converted into electricity. The potential environmental impacts of constructing and operating the satellite power system are being assessed as a part of the Department of Energy's SPS Concept Development and Evaluation Program. This report is Revision I of the Preliminary Environmental Assessment for the Satellite Power System published in October 1978. It refines and extends the 1978 assessment and provides a basis for a 1980 revision that will guide and support DOE recommendations regarding future SPS development. This is Volume 2 of two volumes. It contains the technical detail suitable for peer review and integrates information appearing in documents referenced herein. The key environmental issues associated with the SPS concern human health and safety, ecosystems, climate, and electromagnetic systems interactions. In order to address these issues in an organized manner, five tasks are reported: (I) microwave-radiation health and ecological effects; (II) nonmicrowave health and ecological effectss; (III) atmospheric effects; (IV) effects on communication systems due to ionospheric disturbance; and (V) electromagnetic compatibility. (WHK)

18557 (DOE/EV—0054) **Assessment of solar energy within a community: summary of three community-level studies.** Ritschard, R.L. (Department of Energy, Washington, DC (USA). Div. of Technology Assessments). Oct 1979. 37p. Dep. NTIS, PC A03/MF A01.

This summary report is part of the Technology Assessments of Solar Energy Systems (TASE) project supported by the US Department of Energy, Technology Assessments Division/Office of Technology Impacts, Assistant Secretary for Environment. The objective of the TASE project is to provide policymakers an analysis of the potential health, environmental, and social/economic consequences of large-scale (national in scope) commercialization of solar technologies. A summary of three studies concentrating on the potential community-level impacts of such commercialization is given. The results of these studies provide enrichment of the national-level TASE project by identifying for policymakers specific community-level issues that may arise as a result of federal policy. The three studies are: (1) community-level environmental impacts of decentralized solar technologies; (2) community impediments to implementation of solar energy; and (3) three solar urban futures: characterizations of a future community under three energy supply scenarios.

18558 (DSE—5255-T1) **Building codes as barriers to solar heating and cooling of buildings.** Meeker, F.O. III. (Environmental Law Inst., Washington, DC (USA)). Apr 1978. Contract EM-78-C-01-5255. 51p. Dep. NTIS, PC A04/MF A01.

The application of building codes to solar energy systems for heating and cooling of buildings is discussed, using as typical codes the three model building codes most widely adopted by states and localities. Some potential barriers to solar energy systems are found, federal and state programs to deal with these barriers are discussed, and alternatives are suggested. To remedy this, a federal program is needed to encourage state adoption of standards and acceptance of certification of solar systems for code approval, and to encourage revisions to codes based on model legislation prepared for the federal government by the model codes groups.

18559 (ORNL/TM—7078) **Review of legal and institutional issues in the use of decentralized solar energy systems.** Schweitzer, M. (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 143p. Dep. NTIS, PC A07/MF A01.

The legal and institutional issues involved in the use of decentralized solar energy systems are examined for the purpose of advising government planners and policymakers, the solar industry, solar researchers, and prospective solar users of present and potential impediments and incentives to solar commercialization. This information was gathered primarily through a comprehensive literature review, with supplementary data provided through interviews with representatives of organizations active in the solar field. Five major issue areas were identified in the course of this study: (1) prohibitions on the use of solar equipment, (2) regulation of the production and placement of solar systems, (3) access to sunlight, (4) financial incentives and impediments to the use of solar technologies, and (5) the public utility-solar user interface. Each can be important in its impacts on the incidence of solar usage. The major actors involved with the issues identified above represent both the private and public sectors. Important private sector participants include solar manufacturers and installers, labor unions, lending institutions, utility companies, solar users themselves, and other community property owners. In the public sector, local, state, and federal governments are all capable of acting in ways that can influence the solar commercialization effort. Implementation options are available for all levels of government seeking to take an active role in addressing the previously mentioned legal and institutional issues. The appropriate actions will vary from federal to state to local governments, but each level can be important in removing existing barriers and creating new incentives for solar use.

SOLAR ENERGY CONVERSION

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 18608, 18613, 18614, 18753, 19134, 19139

18560 (BNL—27334) **Avoiding future health problems related to photovoltaic technology.** Stang, L. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract EY-76-C-02-0016. 10p. (CONF-800334—1). Dep. NTIS, PC A02/MF A01.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

Environmental, health, and safety aspects of photovoltaic technology are discussed, and the role of Brookhaven National Lab as DOE's field center for research and advice in this area is described. (WHK)

18561 (CONF-790457—9) **Photovoltaic effect, its present understanding and remaining mysteries.** Boeer, K.W. (Delaware Univ., Newark (USA)). 1979. Contract AC01-79ET23103. 5p. Dep. NTIS, PC A02/MF A01.

From 1979 photovoltaic solar energy conference; West Berlin, F.R. Germany (23 Apr 1979).

The present understanding and various areas in need for improved understanding of the photovoltaic effect are reviewed. (WHK)

18562 (COO—4726-1-T1) **Cuprous oxide photovoltaic cells. Final report, September 1, 1978-November 30, 1979.** Trivich, D. (Wayne State Univ., Detroit, MI (USA). Dept. of Chemistry). 1979. Contract ET-78-S-02-4726. 57p. Dep. NTIS, PC A04/MF A01.

The research described represents the beginning of a second phase of research on cuprous oxide photovoltaic cells. The first phase was concerned with the development of procedures of making Schottky barriers on isolated films of Cu_2O, including single crystals. It was found that properties of these Schottky barrier cells, in particular the barrier heights, were limited by chemical changes at

the junction especially with metals of low work function which tend to be more active chemically, e.g., Al. The motivation of the present phase of the research was to construct junctions that would avoid this chemical degradation while maintaining electrical contact between the Cu_2O and a low work function material in order to attain larger barrier heights. Essentially the approach involved placing the Cu_2O in contact with a stable oxide. When this oxide is used as a thin layer between the Cu_2O and a top metal contact this gives an MIS structure. As another approach the other oxide can be an n-type semiconductor in thicker layers to form a heterojunction. Results are reported. (WHK)

18563 (CRN-CPR—78-12) **Realization of p-n junction solar cells by an ion implantation doping procedure.** Muller, J.C.; Hage-Ali, M.; Siffert, P. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1978. 17p. (CONF-7805196—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From International symposium workshop on solar energy; Cairo, Egypt (16 May 1978).

The possibility of using a low cost ion implantation procedure for the preparation of junction solar cells has been investigated. The method employs a d.c. glow discharge ion source and a short post acceleration structure, without any mass separation. Preparation of the cells in a continuous way is possible at competitive speeds since the ion beam current density reaches 1 mA/cm^2. The properties of silicon cells, obtained by discharge bombardment in BF_3 or PF_5 atmosphere followed by recristallisation of the damaged layer either by thermal annealing or fast surface laser pulses, have been investigated. Rutherford backscattering, SIMS, electrical measurements have been used. Finally, characteristics and performance of the devices are presented.

18564 (DOE/ET/20409—4) **Thin films of gallium arsenide on low-cost substrates. Final report, October 1, 1976-September 30, 1977.** Nelson, N.J. (Varian Associates, Inc., Palo Alto, CA (USA)). Nov 1977. Contract EY-76-C-03-1288. 40p. Dep. NTIS, PC A03/MF A01.

The program objective was the determination of the necessary parameters for production and deployment of a thin-film high efficiency GaAs photovoltaic system for installation at a 50 GW/year rate. Assuming a 100% utilization of Ga and a conversion efficiency of 13%, a thin-film GaAs system at 50 GW/year would require 1000 tons of Ga per year per micron of contained GaAs; this latter figure roughly coincides with the projected annual US production of Ga. Therefore, the real thin-film GaAs system will have to be restricted to an active GaAs layer of 1 micron. Within this limit it is still desirable to have a p-n junction device in GaAs and grain areas of at least (10 micron)^2 to achieve usable efficiencies. These boundary conditions place severe and critical requirements upon the GaAs growth technique and upon the selection of a suitable substrate. The organometallic-sourced CVD process for thin-film GaAs preparation on ideal substrates (single-crystal GaAs for ease of materials characterization) and real system models (polycrystalline GaAs and Ge) are studied, the latter to check the applicability of the former towards ultimate utility in the real system. Progress is reported. (WHK)

18565 (DOE/ET/23009—T2) **Thin film cadmium telluride solar cells. Technical progress report No. 2, October 1-December 31, 1979.** Chu, T.L. (Southern Methodist Univ., Dallas, TX (USA)). Jan 1980. Contract AC04-79ET23009. 25p. Dep. NTIS, PC A02/MF A01.

The objectives of this contract are to investigate thin films of cadmium telluride on low cost substrates and to demonstrate the feasibility of producing thin film cells with a conversion efficiency of 10% or higher. The chemical vapor deposition of cadmium telluride films on foreign substrates by the direct combination of the elements has been further investigated. Inert substrates such as graphite and tungsten/graphite are not suitable for the deposition of device quality cadmium telluride films because of the rectifying interface and pinhole problems. Indium coated W/graphite forms an ohmic contact with n-type cadmium telluride, and the deposited films are essentially free of pinholes. The properties of Ag/n-CdTe/In/W/graphite structures, such as the current-voltage characteristics as a function of temperature, the barrier height, the photovoltaic properties, and the intragrain diffusion length in cadmium telluride, have been investigated. Preliminary work has also been carried out on the deposition of p-type cadmium telluride films on Sb/W/graphite substrates. The reaction between cadmium iodide and tellurium in a hydrogen atmosphere has been concluded to be unsuitable for the deposition of cadmium telluride films.

18566 (DOE/ET/23011—T1) **Boron arsenide thin film solar cell development. Quarterly report No. 1.** Boone, J.L.; Van Doren, T.P. (Missouri Univ., Rolla (USA). Dept. of Electrical Engineering; Eagle-Picher Industries, Inc., Miami, OK (USA). Miami Research Labs.). Jul 1979. Contract AC04-79ET23011. 56p. Dep. NTIS, PC A04/MF A01.

A large portion of the effort expended in the first quarter was devoted to the design, assembly, and testing of the film growth apparatus. The reactor has been completed and tested by depositing boron from diborane gas onto heated quartz substrates. The objective of this effort was to achieve film growth, which has been accomplished. Within the last month, attempts to grow boron arsenide films have been made by introducing both diborane and arsine into the reactor. Thin films have been grown on quartz and sapphire (alumina) substrates. Variations in film thickness, composition, degree of crystallinity, and conductivity have been observed as a result of variation of the deposition parameters, such as type and flow rate of carrier gases, substrate temperature, and substrate materials. X-ray analysis of several samples indicates that films containing boron and arsenic have been grown. No crystalline films have been produced to date. Electrical and optical measurements indicate some correlation between at least one of the films grown and the results achieved by Chu, et al. on BAs. Thus far, the electrical conductivity, film topography, optical absorption, index of refraction, impurity type, and photo-conductivity have been investigated on one sample. This material appears to be B/sub x/As/sub y/ and could be BAs. Further investigations will be required to be conclusive.

18567 (DOE/ET/23044—T3) **Deposition, fabrication and analysis of polycrystalline silicon mis solar cells. Quarterly technical progress report No. 3, July 1-September 30, 1979.** Anderson, W.A. (State Univ. of New York, Buffalo (USA). Lab. for Power and Environmental Studies). 30 Oct 1979. Contract AC03-79ET23044. 54p. Dep. NTIS, PC A04/MF A01.

A computer model has been established to predict MIS solar cell performance as a function of semiconductor and solar cell design parameters. The solar cell fabrication procedure was modified to more carefully examine the effect of t/sub ox/. An oxide growth temperature of 550 to 600°C was shown to give good values of FF, V/sub oc/, and J/sub sc/ which gave efficiency values consistently in the 9 to 10% range on Xtal-Si and 6.5 to 7.5% range on poly-Si. This revised process increased the average solar cell efficiency but did not increase maximum efficiency due to other parameters which were not optimum. I-V data for $77^\circ K < T < 400^\circ K$ were obtained for MIS solar cells on poly.-Si. Unpolished poly.-Si was shown to give space charge limited conduction indicative of a Gaussian trap distribution. Polished poly.-Si gave a tunneling mechanism at low temperatures and tunneling via interface states at higher temperatures. Electron beam deposition of thin (20 μm) Si films on Al coated stainless steel was resumed during this quarter. These films showed good adhesion to the metal substrate. SEM studies revealed columnar growth with 5 μm dia columns. Radiation effect studies on MIS solar cells revealed an increased interface state density for proton and electron-irradianced solar cells. Auger studies on an oxide-covered Si surface reveal a mixture of silicon oxide and oxygen atoms chemisorbed to the Si surface. (WHK)

18568 (DOE/ET/23046—2) **Electrodeposition of polycrystalline and amorphous silicon for photovoltaic applications. Quarterly technical progress report No. 02, September 11, 1979-November 30, 1979.** Rauh, R.L.; Rose, T.L.; Hoover, T.G.; Natwig, D.L. (EIC Corp., Newton, MA (USA)). Feb 1980. Contract AC03-79ET23046. 26p. Dep. NTIS, PC A03/MF A01.

Electrochemical measurements were made on $SiHCl_3$ and $(CH_3)_3SiCl$ to determine if they were suitable precursors for electrodepositing silicon from organic solvents. The precursors were dissolved in solutions of propylene carbonate containing 0.1M tetrabutylammonium tetrafluoroborate (TBATFB). Cyclic voltammograms of the systems were run at 25°C and 70°C using Pt as the reference electrode and Pt, Al, or Mo wires as the working electrode. The results showed that the two peaks appearing between 0 and -1.0V could be attributed to impurities made electroactive by addition of the silicon precursor. Reduction to silicon occurred with $SiHCl_3$ between -1.0 to -2.8V; however, for $(CH_3)_3SiCl$, no reduction leading to silicon deposition was observed in this region. Several deposits of silicon were done potentiostatically on Mo, Al, and Ni discs. The thickness, surface finish and color of the amorphous deposits were dependent on the precursor concentration, temperature and material, and surface finish of the metal working electrode. The best deposit was done at elevated temperatures (70°C) on polished Mo. Attempts to deposit silicon from high temperature molten salts were plagued by corrosion problems and shorting of the electrodes inside the crucible. These problems are being corrected by replacing the original cell with a heavier walled material to use while designing a larger and more versatile apparatus.

18569 (DOE/ET/23103—10) **Shape of current-voltage characteristics of solar cells. Theory of thin-film photovoltaics. Technical report No. 2.** Boeer, K.W. (Delaware Univ., Newark (USA). Coll. of Engineering). 1979. Contract AC01-79ET23103. 39p. Dep. NTIS, PC A03/MF A01.

By proper integration of Poisson and transport equations, considering the junction boundary conditions, current-voltage characteristics of a wide variety of shapes are obtained. The shape depends critically on these boundary conditions and on material properties. In turn, deviation from the ideal characteristic can be used to determine several material properties of a photovoltaic

device. It is possible to categorize deviation from the ideal diode behavior and use simple approximations to obtain defect level distribution, interface recombination velocity and critical fields for field related junction effects. This discussion augments the previous model using a resistive network to alter characteristics and modifies the model using diodes of different A-factors in the exponent. It assists in analyzing less than perfect solar cells to obtain directions for possible improvements.

18570 (DOE/JPL/1012—29) **Progress report 13 for April 1979-August 1979 and proceedings of the 13th project integration meeting.** (Jet Propulsion Lab., Pasadena, CA (USA)). 1979. Contract EX-76-A-29-1012. 462p. Dep. NTIS, PC A20/MF A01.

This report describes progress made by the Low-Cost Solar Array Project during the period April through August 1979. It includes reports on project analysis and integration; technology development in silicon material, large-area sheet silicon, and encapsulation; production process and equipment development; engineering and operations, and a discussion of the steps taken to integrate these efforts. It includes a report on, and copies of viewgraphs presented at the Project Integration Meeting held August 22-23, 1979.

18571 (DOE/JPL/954442—78/12) **Semiconductor grade, solar silicon purification project. Final technical report.** Ingle, W.M.; Rosler, R.S.; Thompson, S.W.; Chaney, R.E. (Motorola, Inc., Phoenix, AZ (USA). Semiconductor Group). 10 Dec 1979. Contract NAS-7-100-954442. 172p. Dep. NTIS, PC A08/MF A01.

Motorola's low cost poly silicon program is described. In the process, SiF_4, a low cost by-product is reacted with mg silicon to form SiF_2 gas which is polymerized. The (SiF_2)/sub x/ polymer is heated forming volatile Si/sub x/F/sub y/ homologues which disproportionate (C.V.D.) on a silicon particle bed forming silicon and SiF_4. During the initial phases of the investigation the silicon analysis procedure relied heavily on S.S.M.S. and E.S. analysis. This analysis demonstrated that major purification had occurred and some samples were indistinguishable from semiconductor grade silicon (except possibly for phosphorus). However, more recent electrical analysis via crystal growth reveals that the product contains compensated phosphorus and boron. Work on the control or removal of the electrically active donors and acceptors could yield a product suitable for solar application. The low projected product cost and short energy payback time suggest that the economics of this process will result in a cost less than the J.P.L./D.O.E. goal of $10/Kg (1975 dollars). Finally, assuming a successful demonstration of a pilot facility, the process appears to be readily scalable to a major silicon purification facility as was proposed by Motorola and R. Katzen.

18572 (DOE/JPL/954471—79/12) **Novel duplex vapor-electrochemical method for silicon solar cells. Quarterly process report No. 15, August 1-November 30, 1979.** Nanis, L.; Sanjurjo, A.; Sancier, K. (SRI International, Menlo Park, CA (USA)). 10 Dec 1979. Contract NAS-7-100-954471. 32p. Dep. NTIS, PC A03/MF A01.

The SiF_4-Na reaction (Task 1) system has been scaled up to an Inconel reactor with an 18-cm inside diameter. Production rates of 1.8 kg Si per hour have been achieved with complete utilization of Na. The melt-separation system (Task 2) has been enlarged to yield about 0.5 kg Si per batch with continuous feeding of reaction products. Silicon from melt-separation (two runs) has been analyzed for impurity content by neutron activation analysis, spark source mass spectrometry, and plasma emission spectroscopy. Nearly all elements detrimental to solar cell efficiency are at or below the 1 ppM (wt) level, including Ti, V, Zr, and Mo. Only Fe, Cr, and Ni are in the range 1 to 10 ppM. Initial experiments are reported for combining the SiF_4-Na reaction with simultaneous melt-separation of Si and NaF.

18573 (DOE/JPL/954527—79/11) **Investigation of test methods, material properties, and processes for solar cell encapsulants. Annual report.** Willis, P.B., Baum, B. (Springborn Labs., Inc., Enfield, CT (USA)). Jun 1979. Contract NAS-7-100-954527. 128p. Dep. NTIS, PC A07/MF A01.

The goal of this program is to identify, evaluate, and recommend encapsulant materials and processes for the production of cost-effective, long-life solar cell modules. During the past year, the technical activities emphasized the reformulation of a commercial grade of ethylene/vinyl acetate copolymer for use as a pottant in solar cell module manufacture. After experimenting with a variety of techniques, a vacuum-bag process was developed and found to be an excellent encapsulation method. Adhesive strengths and primers for the bonding of ethylene/vinyl acetate to superstrate and substrate materials was assessed with encouraging results. The weathering effects on ten other polymers exposed to twelve months of weathering in Arizona, Florida, and under EMMAQUA were evaluated by determination of tensile strengths, elongations, optical transmission, etc. As may be expected, the best overall retention of mechanical properties is found for the fluorocarbon polymers, especially FEP. Hard coatings containing ultraviolet absorbers were investigated for the purpose of providing a soil resistant surface and additional weathering stability to the soft EVA pottant. Corrosion studies using a standard salt spray test were used to determine the degree of protection offered to a variety of metals by encapsulation in EVA pottant. A survey of scrim materials was also conducted. These open hole weaves are intended for use as spacers between the cell and substrate to provide a mechanical barrier, improve insulation resistance and prevent migration of the pigmented pottant over the cell surface. A mechanical engineering analysis of composite structural materials for use as substrates was performed. Results are presented in detail. (WHK)

18574 (DOE/JPL/954830—2) **Assessment of present state-of-the-art sawing technology of large diameter ingots for solar sheet material. Final report, September 1, 1977-February 28, 1978.** Yoo, H.I. (Optical Coating Lab., Inc., City of Industry, CA (USA). Photoelectronics Div.). 1978. Contract NAS-7-100-954830. 130p. Dep. NTIS, PC A07/MF A01.

The objective of this program is to assess the present state-of-the-art sawing technology of large diameter silicon ingots (3" and 4" diameter) for solar sheet materials. During this program, work has progressed in: (1) slicing of the ingots with the multiblade slurry (MBS) saw, the multiwire slurry (MWS) saw and the I.D. saw, (2) characterization of the sliced wafers, and (3) analysis of add-on slicing cost based on SAMICS. Multiblade slurry slicing resulted in mechanical wafer yields of 95% for the 3" diameter ingot and 84% for the 4" diameter ingot (using a 230 blade package to cut 6" ingot in length). A slicing test with the I.D. saw was performed to obtain mechanical yield versus both wafer thickness and cut rate, and the result showed a good yield (above 95%) down to 7 to 8 mils of wafer thickness for the 3" wafers and 11 to 12 mils for the 4" wafers if the cut rates were reduced to 1" per minute. An ingot of 3" in diameter and 3" in length was sliced with a multiwire slurry saw to obtain wafer yield of about 97%; 163 wires were used, and wafer thickness and kerf width were 10 to 11 mils and 8 mils, respectively. Thickness, taper, bow, and roughness (RMS) were measured to characterize the sliced wafers. Four in. wafers sliced wih the multiblade slurry saw showed larger thickness variation (wafer to wafer) and more taper than 3" wafers. Wafers sliced with the I.D. saw indicated that taper, bow, and roughness increased as the cut rate increased. Comparison showed the wafers cut with the I.D. saw (sliced below 3" per minute of cut rate) and the multiwire slurry saw have much smaller values and variations than those cut with the multiblade slurry saw, indicating the need for less removal of silicon before solar cell formatior.

18575 (DOE/JPL/954851—79/2) **X-ray measurements of stresses and defects in EFG and large grained polycrystalline silicon ribbons.** Wagner, C.N.J. (California Univ., Los Angeles (USA). Dept. of Materials). Aug 1979. Contract NAS-7-100-954851. 22p. Dep. NTIS, PC A02/MF A01.

The Bond method has been employed to measure the lattice parameter a in an area of 0.4 mm in diameter of EFG Si-ribbons to an accuracy of +- 0.00008 A. A Bond goniometer was built which included a goniostat with a special specimen holder to mount ribbons 1 m in length and 75 mm in width which could be rotated about two orthogonal axes, and a Leitz microscope for precision alignment of a particular area into the center of the goniostat and the small primary x-ray beam. The (321) planes were found to be parallel to the surface of the ribbons with an angular spread of about 15°. The poles of the (111) planes clustered about an angle of 25° away from the surface normal, again with a spread of 10°. The lattice parameter of a small piece of ribbon material was found to be $a_0 = 5.43075$ A. Converting the observed strain ϵ ($= [a-a_0]/a_0$) into the sum of the principal surface stresses $\sigma_1 + \sigma_2$ assuming that the tilt angles of less than 15° can be neglected yielded values of $\sigma_1 + \sigma_2$ which were zero within the accuracy of our measurements of +- 10 MPa, but a maximum stress of 115 MPa was observed in a fractured ribbon which corresponded to the fracture stress of single crystals of Si.

18576 (DOE/JPL/954853—79/7) **Investigation of proposed process sequence for the array automated assembly task: Phase II. Quarterly technical progress report for quarter ending September 29, 1979.** Mardesich, N.; Garcia, A.; Bunyan, S.; Sipperly, B. (Spectrolab, Inc., Sylmar, CA (USA)). Nov 1979. Contract NAS-7-100-954853. 41p. Dep. NTIS, PC A03/MF A01.

Plasma etching was investigated as a possible surface preparation process, the Radiation Technology Infrared Furnace was tested as a possible replacement for the currently used tube furnace, and the fixture for laminating 2' by 4' panels was completed and panels are currently being tested. Progress is reported in detail. (WHK)

18577 (DOE/JPL/954929—6) **Investigation of reliability attributes and accelerated stress factors on terrestrial solar cells. Sixth quarterly report, July 1-October 1, 1979.** Prince, J.L.; Lathrop, J.W. (Clemson Univ., SC (USA)). 1 Nov 1979. Contract NAS-7-100-954929. 78p. Dep. NTIS, PC A05/MF A01.

Results obtained during the reporting period include the identification of need for a short-interval solar cell tester and the definition of such a tester, the acquisition of significant amounts of

data on stress-tested cells of two types from most of the planned stress tests, and progress in understanding the types of measurements and methods of measurement appropriate for study of second quadrant cell characteristics. Cells subjected to B-T stress testing at 75°C showed very little P/sub m/ degradation after 1200 to 2500 stress hours. Cells stressed at higher temperatures showed greater degradation; this was especially true of cells subjected to 150°C B-T stress. Significant P/sub m/ degradation was observed for pressure cooker T-H stressed cells. Bias was observed to be an accelerating factor for 85°C/85% R.H. T-H stress, but not for pressure cooker T-H stress.

18578 (DOE/JPL/954977—5) **Quantitative analysis of defects in silicon: silicon sheet growth development for the large area silicon sheet task of the Low-Cost Solar Array Project. Quarterly progress report No. 4, 1 January 1979-31 March 1979.** Natesh, R.; Smith, J.M.; Qidwai, H.A. (Materials Research, Inc., Centerville, UT (USA)). 1979. Contract NAS-7-100-954977. 92p. Dep. NTIS, MF A01.

Portions of document are illegible.

This report describes the various steps involved in the chemical polishing and etching of Motorola silicon samples. Data on twins, dislocation pits, and grain boundaries from thirty-one (31) Mobil Tyco silicon sample numbers 47 to 77 are also discussed. A brief review of the changes made to upgrade the Quantimet 720 Image Analysis System is included.

18579 (DOE/JPL/955055—79/4) **Silicon solar cell process development, fabrication and analysis. Annual report, 22 August 1978-30 September 1979.** Minahan, J.A. (Spectrolab, Inc., Sylmar, CA (USA)). 1979. Contract NAS-7-100-955055. 56p. Dep. NTIS, PC A04/MF A01.

Solar cells have been fabricated from unconventional silicon materials supplied in the Large Area Sheet Task of the Low Cost Solar Array Project. The cells were constructed using methods intended to optimize the efficiency, as well as by a standard method intended to act as a baseline procedure. Following fabrication, all cells have been measured on the Spectrolab Solar Simulator at Air Mass Zero and 28°C. Conversion efficiencies are based upon total device area. Maximum conversion efficiency obtained for Kayex continuous CZ material has been 12.4% (optimized), for Crystal Systems HEM material 11.2% (optimized), for Mobil Tyco EFG (RH) 8.4% (baseline) and EFG (RF) 9.8% (baseline), for Westinghouse Web material 12.0% (optimized), for Motorola RTR 7.2% (baseline), and for Wacker Silso 10.6% (baseline). All of these materials are from Phase I of the Contract. Phase II of the contract has started with Mobil-Tyco EFG (RH) material. Following fabrication by the baseline method this material, as well as the others in the program, will be fabricated using low-cost processing methods.

18580 (DOE/JPL/955244—80/4) **Development of low cost contacts to silicon solar cells. Third quarterly report, 15 October 1979-15 January 1980.** Tanner, D.P.; Iles, P.A. (Optical Coating Lab., Inc., City of Industry, CA (USA). Photoelectronics Div.). 1980. Contract NAS-7-100-955244. 54p. Dep. NTIS, PC A04/MF A01.

The results of the second phase of the program of developing low cost contacts to silicon solar cells using copper are reported. Phase I yielded the development of a plated Pd-Cr-Cu contact system. This process produced cells with shunting problems when they were heated to 400°C for 5 minutes. Phase II was to find means of stopping the later identified copper diffusion which caused the shunting. A contact heat treatment study has been conducted with Pd-Ag, Cr-Ag, Pd-Cu, Cu-Cr and Cr-Ni-Cu. This study has shown nickel to be an effective diffusion barrier to copper. To decrease the cost of the contact system it has been thought that nickel should replace the chromium in the old process. This is the route the last part of the program will take.

18581 (DOE/JPL/955278—79/4) **Automated solar panel assembly line. LSA task: production processes and equipment. Quarterly report No. 4.** (ARCO Solar, Inc., Chatsworth, CA (USA)). 8 Jan 1980. Contract NAS-7-100-955278. 18p. Dep. NTIS, PC A02/MF A01.

The objective of this program is to design, fabricate and demonstrate an automated solar cell module production line with the ultimate goal of reducing module assembly costs. During this quarter the fabrication and assembly phases of the soldering maching commenced. Lamination chambers for the auto-pilot line were completed. Albuquerque Laboratory, Ardev Inc., is under subcontract to develop the soldering equipment on this program. The lamination development is being done by ARCO Solar, Inc.

18582 (DOE/JPL/955282—79/3) **LSA large area silicon sheet task enhanced I.D. slicing. Quarterly report No. 3, July-September 1979.** Walters, D. (Siltec Corp., Menlo Park, CA (USA)). Oct 1979. Contract NAS-7-100-955282. 36p. Dep. NTIS, PC A03/MF A01.

Efforts to make ingot technology cost effective for the production of low cost solar cells in the 1980 to 1986 timeframe have been divided into both the development of a continuous CZ growth process and advanced ingot slicing. The direction of this program is aimed towards the development and demonstration of enhanced I.D. slicing technology that will significantly increase the number of usable slices per inch of ingot over industry practice. This method will require a reduction of both blade and slice thickness. The required technologies to achieve these goals are: ingot rotation with minimum exposed blade area, dynamic cutting edge control, and the use of prefabricated insert blades. Demonstration runs, incorporating ingot rotation with minimum exposed blade area in the slicing process, were performed. These tests demonstrated clearly that control of the cutting edge position is required for blades with cores $< 90\ \mu$ to assure minimum blade deflection as well as cutting stability at a reasonable cutting feed rate. Blade development efforts to reduce kerf loss of 152 μ through introduction of a prefabricated insert are continuing. An alternative blade construction requiring special etching techniques was developed which will produce a kerf of 152 μ. The blades are presently manufactured and will undergo extensive testing shortly.

18583 (DOE/JPL/955287—5) **Automated solar module assembly line. Quarterly technical report No. 5.** Bycer, M. (Kulicke and Soffa Industries, Inc., Horsham, PA (USA)). Mar 1980. Contract NAS-7-100-955287. 29p. Dep. NTIS, PC A03/MF A01.

Progress discussed includes the work performed in the building and checking out of the first half of the machine (which includes the cassette unload, cell orient and flux application and first interconnect (bond) stations) in the manual, semi-automatic, and automatic modes. The machine which Kulicke and Soffa is to deliver under this contract is to be capable of handling a variety of cells and assembling strings of cells which can then be placed in a matrix up to 2' x 4' in series or parallel arrangement. The target machine cycle is to be 5 seconds per cell. This machine will be primarily adapted to 3 in. dia round cells with 2 tabs between cells. The bonding interconnect technique to be utilized is pulsed heat technology. The microprocessor control system utilized for this piece of equipment is a standard K and S computer that was modified for this application. The preliminary checkout of the first half of the machine confirmed that the 5 sec/cycle goal has been realized in this section of the machine.

18584 (DOE/JPL/955287—79/4) **Automated solar module assembly line. Quarterly technical report No. 4.** Bycer, M. (Kulicke and Soffa Industries, Inc., Horsham, PA (USA)). Dec 1979. Contract NAS-7-100-955287. 27p. Dep. NTIS, PC A03/MF A01.

Progress discussed includes the work performed in the design and building of the first half of the machine (which includes the cassette unload, cell orient and flux application and first interconnect (bond) stations) as well as on the string conveyor and vacuum transfer system. The machine which Kulicke and Soffa is to deliver under this contract is a cell stringing and string applique machine which will be flexible in design, capable of handling a variety of cells and assembling strings of cells which can then be placed in a matrix up to 2' x 4' in series or parallel arrangement. The target machine cycle is to be 5 s per cell. This machine will be primarily adapted to 3 in. dia round cells with one or two tabs between cells. The design of the machine will be flexible so that it can be modified to handle other cell sizes, string lengths and module arrangements. The bonding interconnect technique to be utilized is pulsed heat technology. The microprocessor control system utilized for this piece of equipment is a standard K and S computer that was modified for this application. The block diagram and flow chart for the first half of the machine are included. The string conveyor was modified to eliminate the problem of gear tooth and belt sprocket hole pitch. Tests were successfully performed on the vacuum wand of the vacuum transfer system with a full complement of fifteen (15) 3 in. dia solar cells and two (2) of the same cells to represent the minimum partial string.

18585 (DOE/JPL/955342—2) **Development of Megasonic cleaning for silicon wafers.** Mayer, A. (RCA Solid State Div., Somerville, NJ (USA); RCA Labs., Princeton, NJ (USA)). 1 Oct 1979. Contract NAS-7-100-955342. 21p. Dep. NTIS, PC A02/MF A01.

The Megasonic cleaning system was integrated and debugged. The system consists of the Megasonic cleaning sink, a rinse station, an air dryer, and an inspection station equipped with a laser scanner for the detection of light-scattering centers on a wafer. The recirculation-filtration system is operating satisfactorily. The preliminary data on wafer cleaning and rinsing indicate that the design criteria of cleaning ability, chemicals usage, ease of operation, and safety have been largely met. Further work on production rate is needed. The air dryer has been demonstrated to function. Its true throughput can be evaluated only when the belt drive has been installed. The long delivery time will cause some delay in moving the system to the RCA Mountaintop location for production evaluation.

18586 (DOE/JPL/955382—79/3) **Low-cost solar array project. Task I. Silicon material: investigation of the hydrogenation of $SiCl_4$. Third quarterly report.** Mui, J.Y.P. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemistry). 4 Jan 1980. Contract NAS-7-100-955382. 34p. Dep. NTIS, PC A03/MF A01.

A laboratory stainless steel reactor has been constructed and installed to study the hydrogenation of $SiCl_4$, 3 $SiCl_4$ + 2 H_2 + Si reversible arrow 4 $SiHCl_3$. The reactor is designed to operate at pressure up to 500 psig which is the proposed operating pressure range of the Union Carbide EPSDU; silane-to-silicon process. Series of experiments were carried out to measure the reaction kinetics. The effect of reactor temperature on the rate of the hydrogenation of $SiCl_4$ to $SiHCl_3$ was measured at 400, 450, 500 and 550°C. As expected, the reaction rate increases rapidly with increasing reactor temperature. The reaction rate and $SiHCl_3$ conversion were studied as functions of hydrogen and $SiCl_4$ concentrations at $H_2/SiCl_4$ ratios of 1.0 and 2.8. Higher H_2SiCl_4 ratio produces a higher $SiHCl_3$ conversion per pass while the reaction rate remains approximately the same. The effect of reactor pressure on the rate of the hydrogenation reaction is most interesting. The rate of approaching equilibrium at higher reactor pressure (500 psig) is somewhat slower than those at lower reactor pressure (300 psig). In general, the 500 psig experimental data confirm previous estimated results which were obtained by extrapolating from lower reactor pressure data. Results of these experimental data show that the highest product $SiHCl_3$ output for a given reactor size is achievable by operating the hydrogenation process at maximum reactor temperature and pressure.

18587 (DOE/SF/23047—3) **Thin film polycrystalline silicon solar cells. Quarterly report No. 3, July 1, 1979-September 30, 1979.** Ghosh, A.K.; Feng, T.; Maruska, H.P. (Exxon Research and Engineering Co., Linden, NJ (USA). Advanced Energy Systems Labs.). 1979. Contract AC03-79ET23047. 30p. Dep. NTIS, PC A03/MF A01.

The details of the fabrication procedures for making SnO_2/n-Si, ITO/n-Si, and MIS solar cells are given. Using a low cost and highly reproducible spray deposition process for tin oxide and indium tin oxide, we made SnO_2/n-Si and ITO/n-Si, solar cells with power conversion efficiencies of 10 and 13% for polycrystalline (Wacker) and single crystal silicon, respectively. Continued improvements in the efficiencies of diffused p-n junction cells were made; efficiencies of 10.3 and 9% were obtained for polysilicon (Wacker) cells of 1- and 20-cm^2 sizes, respectively. The effects of grain boundaries on the generation of photocurrent were studied using the EBIC technique. In addition to using the intensity modulated mode, a y- modulation technique, which gave more details, was used in the EBIC studies. By studying the Hall mobility of polysilicon in the dark and under illumination, we have developed a phenomenological theory which is capable of explaining the observed resistivity and mobility results. A comparison of the spectral response curves of SnO_2/n-Si heterojunction and diffused p/n junction cells indicates a lower diffusion length in the diffused cells. The stability studies of the SnO_2/n-Si cells were continued.

18588 (DSE—3421-T1) **Physical models of thin film polycrystalline solar cells based on measured grain-boundary and electronic-parameter properties. Final report, September 18, 1978-December 31, 1979.** Lindholm, F.A.; Fossum, J.G.; Holloway, P.A.; Neugroschel, A. (Florida Univ., Gainesville (USA). Coll. of Engineering). 1979. Contract ET-78-C-01-3421. 18p. Dep. NTIS, PC A02/MF A01.

The research has sought the following: to identify and characterize the basic photovoltaic mechanisms that govern the conversion efficiency of polycrystalline thin-film solar cells; to experimentally determine the electronic parameters related to these photovoltaic mechanisms; and to relate these mechanisms and parameters to the conversion efficiency through theoretical physical models developed for engineering design. These objectives are all intimately related. The emphasis of the work has been on polysilicon, although it is building a foundation of understanding useful for similar research in the future on other thin-film materials. Progress is reported. (WHK)

18589 (DSE—4042-T13) **Cadium sulfide/copper ternary heterojunction cell research. Technical progress quarterly report, July 1, 1979-September 30, 1979.** (Sperry Univac, St. Paul, MN (USA)). 1979. Contract EG-77-C-01-4042. 13p. Dep. NTIS, PC A02/MF A01.

Third quarter activities on a CdS/$CuInSe_2$ cell research program are discussed. Two methods of fabricating the thin film $CuInSe_2$ are being investigated, dual source evaporation and flash evaporation of $CuInSe_2$ powder. A variety of measurements on the dual source system indicates that layered films are being produced due to decomposition of the $CuInSe_2$ in the melt. Alternative Cu-Se and In-Se melts have been studied for use in the dual source system. P type films or films which can be annealed p type have been obtained from the flash evaporation system using $CuInSe_2$ powder that was prebaked to 550°C in vacuum. Indications are that both sufficient Cu and Se are required for p type conductivity.

18590 (DSE—4042-T29) **Development of high efficiency cascade solar cells. Quarterly technical progress report No. 2.** (Research Triangle Inst., Research Triangle Park, NC (USA)). 31 Dec 1979. Contract EG-77-C-01-4042. 15p. Dep. NTIS, PC A02/MF A01.

Research has continued in the development of selected ternary and quaternary III-V materials that are potential candidates for cascade solar cell applications. In addition, various simple and multijunction cascade solar cell components have been fabricated and evaluated in a continuing study of several different solar cell designs (materials combinations). During the present reporting period, work has concentrated on the following major areas: GaAlAs/GaAs cell development; AlGaAsSb/GaAsSb materials development; GaInP materials development via VPE; inverted structure development; and MO/CVD growth system work at NCSU. Progress in each of these areas is summarized.

18591 (HEDL—6694) **Materials analysis methods for examination of solar cells.** Wilson, C.N. (Comp.). (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1980. Contract EY-76-C-14-2170. 97p. Dep. NTIS, PC A05/MF A01.

Photovoltaic device performance depends on properties of thin-surface and near-surface layers of solid-state materials. Cell structures being investigated by SERI subcontractors for solar cells typically involve one or more thin-film layers of semiconducting material. The chemical and physical structure of these layered material systems affects photovoltaic cell performances. In particular, the composition, abruptness, and chemical nature of layer interfaces are important. Also of interest is the degree of crystallinity, grain size and orientation, and the physical nature of grain boundaries within the various layers. Comprehensive examination of the structure and chemistry of photovoltaic materials requires application of several analysis methods. An overview of materials analysis methods and a summary of capabilities of several methods available at HEDL are presented.

18592 (SAND—78-7072/1/2) **Concentrating array production process design. Volume I. Study summary. Volume II. Study results. Final report.** (General Electric Co., Philadelphia, PA (USA). Valley Forge Space Center). Mar 1980. Contract EY-76-C-04-0789. 213p. Dep. NTIS, PC A10/MF A01.

Existing P/V concentrator designs are evaluated in terms of their performance and low production and life cycle cost potential. Alternate designs and modifications are defined that will be potentially less costly to produce in large scale production. Manufacturing processes commensurate with four levels of production (10^4, 10^5, 10^6, and 10^7 m^2 of aperture per year) are defined for a prime array design. Manufacturing and life cycle costs are determined as a function of production level, array category, and salient design features, e.g., optical type. (WHK)

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 18521, 18522, 18523, 18524, 18525, 18526, 18527, 18528, 18529, 18530, 18531, 18532, 18533, 18534

18593 (CONF-781235—P1, pp 299-300) **Florida water hyacinths to methane.** Brown, J.G. 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18594 (DOE/ET/20605—4) **Preparation of a cost data bank for DOE/Biomass Energy Systems Branch. Fourth quarterly progress report, July 1-September 30, 1979.** Kam, A.Y.; Dickenson, R.L.; Jones, J.L.; Bomberger, D.C.; Chatterjee, A.K.; Fong, W.S.; Meagher, P.C.; Wilhelm, D.J. (SRI International, Menlo Park, CA (USA)). 1979. Contract EY-76-C-03-0115-141. 82p. Dep. NTIS, PC A05/MF A01.

The preparation of a biomass conversion technology and cost data bank for the Biomass Energy Systems Branch (BES) of DOE/Solar is described. Technical and economic analyses of a number of BES technology options are currently underway. A total of 22 biomass conversion technology options (14 thermochemical and 8 biochemical) have been selected for inclusion in the data bank. These options cover the production of electric power, steam, gases, liquids, and solid fuels from biomass. The majority of the options are believed to be available now or in the near term. A consistent methodology for construction of the data bank has been developed. For each option, the most up-to-date process/product data are gathered and analyzed. A base case is established to generate estimates for plant investments required, operating cost, and product cost. The estimates are then examined systematically to identify and quantify the uncertainties. The uncertainties are combined using statistical methods to produce error band estimates. Preliminary results for catalytic liquefaction (PETC and LBL processes), gasoline from biomass (China Lake process), and MBG from wood, ethanol fermentation are reported here. A sensitivity analysis for cogeneration is also reported.

18595 (DSE—3060-T3) **Design, fabrication and operation of a biomass fermentation facility. Technical progress report No. 3, April 1-July 31, 1979.** O'Neil, D.J.; Colcord, A.R.; Bery, M.K.; Roberts, R.S.; Sondhi, D.K.; Robb, B.C.; Williams, R.R.; Cook, A.A.;

Nachowiak, J.J.; Crider, J.D. (Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station; Sverdrup and Parcel and Associates, Inc., St. Louis, MO (USA)). Aug 1979. Contract ET-78-C-01-3060. 50p. Dep. NTIS, PC A03/MF A01.

Further studies on process economics and optimization for hexose production from wood by dilute acid hydrolysis were conducted. In the previous report, detailed studies on process economics and optimization of hexose production were undertaken for a continuously stirred reactor (CSTR) and a plug flow reactor (PFR). These studies were based on Saeman's kinetics for a Douglas fir substrate. The studies in this report are based on Fagan's kinetics for a Kraft paper substrate. Application to a plug flow reactor and to a fixed bed reactor (FBR) have been undertaken. The initial results, as predicted in an earlier report, indicate that the FBR is at least comparable to a PFR in terms of process economics. Results of these studies are presented in Section 2.0. Section 4.0 describes the progress which has been achieved under Task 2 of this contract, Detailed Engineering Design, which had been interrupted by the unanticipated revisions, and concomitant delay, experienced in obtaining final approval of the conceptual design for the process development unit. The conceptual design of the process development unit is included.

18596 (DSE—4042-T2) **Continuation of systems study of fuels from grasses and grains: Phase 2 and Phase 3. Final report.** McElroy, A.D.; Tinberg, C.; Davis, M.; Snyder, M.; Allen, A.D. (Midwest Research Inst., Kansas City, MO (USA)). 31 Jul 1979. Contract EG-77-C-01-4042. 195p. Dep. NTIS, PC A09/MF A01.

Results are presented of an investigation of biomass-derived fuels from grasses and grains. A region-by-region analysis of biomass production, with both the present (near-term) and the future (mid-term) being considered is presented. The overall approach for analysis of the near-term involved least cost analysis of production, transportation, and energy conversion. The mid-term analyses were structured around the assumed implementation of modified crop production systems in which land was more extensively used in a given region, improved crop management practices were used, and the crop mixes were significantly altered from the present. The production systems in the several regions were combined with conversion plants ranging in size from 500 oven-dry (OD) tons/day to 3000 OD tons/day, or an energy imput of 75 x 10^9 Btus to 45 x 10^9 Btus using 7500 Btus/lb. The conversion processes consisted of anaerobic digestion, fermentation, direct combustion, and thermochemical conversion. The latter process was also considered in the context of production of ammonia and methanol.

18597 (NE—1979-5) **Demonstration plant for methanol production from domestic raw materials.** (Forskningsinstitutet foer Atomfysik, Stockholm (Sweden)). 1979. 93p. (In Swedish). Dep. NTIS (US Sales Only), PC A05/MF A01.

The techniques, markets and possible localization for a demonstration plant for methanol production from peat and biomass are reviewed. High-temperature Winkler or Shell-Koppers gasification processes are preferred. The suggested demonstration plant should have a capacity of 20 kton methanol/year and the investment cost is estimated to about 95 Mskr.

18598 (SERI/TR—8234-1) **Decision-maker's guide to wood fuel for small industrial energy users. Final report.** Levi, M.P.; O'Grady, M.J. (North Carolina State Univ., Raleigh (USA). School of Forest Resources). Feb 1980. Contract EG-77-C-01-4042. 169p. Dep. NTIS, PC A08/MF A01.

The technology and economics of various wood energy systems available to the small industrial and commercial energy user are considered. This book is designed to help a plant manager, engineer, or others in a decision-making role to become more familiar with wood fuel systems and make informed decisions about switching to wood as a fuel. The following subjects are discussed: wood combustion, pelletized wood, fuel storage, fuel handling and preparation, combustion equipment, retrofitting fossil-fueled boilers, cogeneration, pollution abatement, and economic considerations of wood fuel use. (MHR)

18599 (SHG-IST—7) **Drying and storing biomass: needs and methods.** Mattsson, J.E. (Naemnden foer Energiproduktionsforskning, Stockholm (Sweden)). 1979. 140p. (In Swedish). (NE-PROJ—1160271). Dep. NTIS (US Sales Only), PC A07/MF A01.

A review is given of the properties, potentials and harvesting methods for important biomasses, i.e., algae, wood, peat, straw, and reed. Methods for combustion of biomass of different water content are discussed. Problems in drying and storing biomass are reported, and suggestions are made for R and D in the field of drying and storing of biomass.

18600 (SHG-IST—8) **Changes in moisture content and substance loss of birchwood at storage.** Thoerngvist, T. (Naemnden foer Energiproduktionsforskning, Stockholm (Sweden)). 1979. 31p. (In Swedish). (NE-PROJ—3065121). Dep. NTIS (US Sales Only), PC A03/MF A01.

The effective heat content of wood fuel is strongly dependent on the moisture content. This literature study gives an account of the moisture and substance changes of birchwood stored for one or two summer periods.

PHOTOCHEMICAL AND THERMOCHEMICAL CONVERSION

REFER ALSO TO CITATION(S) 18501, 18505, 18514

18601 (CONF-781235—P1, pp 189) **Commercialization of the noval solar cell.** Rastogi, S.C. (M.M.M. Engineering Coll., Gorakhpur, India). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18602 (CONF-781235—P1, pp 367-368) **High energy hybird system: hydrogen-chlorine-solar-water.** Stewart, B.B. (Solar Reactor Corp., Miami, FL). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18603 (CONF-791127—, pp 135-139) **Studies of solar energy storage reactions involving polynuclear rhodium isocyanide complexes.** Gray, H.B.; Miskowski, V.M.; Gupta, A. (California Inst. of Tech., Pasadena). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

The mechanism of photochemical evolution of hydrogen on long wavelength irradiation of solutions of rhodium isocyanide complexes in hydrohalic acids has been studied by measurement of quantum yields of products and by flash spectroscopy. The redox chemistry of these complexes has also been investigated in order to characterize the intermediate oligomeric species which are formed when $Rh_2(br)_4^{2+}$ is dissolved in hydrohalic acids and which initiate the primary photoprocess leading to hydrogen evolution.

18604 (DOE/ER/05528—19) **Solar energy utilization by carbanion photolysis. Progress report on research, 1979-1980.** Fox, M.A. (Texas Univ., Austin (USA). Dept. of Chemistry). 15 Mar 1980. Contract EG-77-S-05-5528. 8p. Dep. NTIS, PC A02/MF A01.

Progress has been made in three categories: (1) chemical modification of semiconductor electrode surfaces; (2) characterization of unique photoreactivity at semiconductor electrodes and powders; and (3) delineation of competitive pathways in the visible-light-induced photoreactions of carbanionic salts. By using photoelectrochemical and spectroscopic techniques to complement product isolation studies, mechanistic pathways for photoelectron transfer reactions have been characterized. Such data are critical for the construction of efficient photoelectrochemical cells, for describing the effect of the photochemical environment on electron transfer processes, and for characterizing thermally-endothermic conversions of carbanions induced by visible light.

PHOTOVOLTAIC POWER PLANTS

REFER ALSO TO CITATION(S) 18556, 18570, 18625, 19094

18605 (CONF-781235—P1, pp 77-79) **Solar breeder.** Filippone, W.L. (Univ. of Lowell, MA). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18606 (DOE/CS/05317—1) **Airport Solar Photovoltaic Concentrator Project. Phase 1 - final report, June 1, 1978-February 28, 1979.** (Arizona Public Service Co., Phoenix (USA); Motorola, Inc., Scottsdale, AZ (USA). Government Electronics Div.). Dec 1979. Contract ET-78-C-04-5317. 347p. Dep. NTIS, PC A15/MF A01.

The system design, analysis, and specification, site preparation, and operation and evaluation plan for a 500 kWe photovoltaic power supply to be located at the Phoenix Sky Harbor International Airport in Phoenix, Arizona, are presented. The solar cell arrays are concentrator silicon solar cells with tracking 70X Cassegrain-type concentrators. The power conditioning system, tracking system, and control systems are described in detal. Environmental impact studies are described. Component specifications and drawings are included. (WHK)

18607 (DOE/CS/94277—1) **50 kW on-site concentrating solar photovoltaic power system. Phase I: design. Final report, 1 June 1978-28 February 1979.** Pittman, P.F. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 30 Mar 1979. Contract ET-78-C-04-4277. 180p. Dep. NTIS, PC A09/MF A01.

This contract is part of a three phase program to design, fabricate, and operate a solar photovoltaic electric power system with concentrating optics. The system will be located beside a Local Operating Headquarters of the Georgia Power Company in Atlanta,

Georgia and will provide part of the power for the on-site load. Fresnel lens concentrators will be used in 2-axis tracking arrays to focus solar energy onto silicon solar cells producing a peak power output of 56 kW. The present contract covers Phase I which has as its objective the complete design of the system and necessary subsystems.

18608 (DOE/CS/95310—1) **Industrial solar breeder project using concentrator photovoltaics.** Hamilton, R.; Wohlgemuth, J.; Burkholder, J.; Levine, A.; Storti, G.; Wrigley, C.; McKegg, A. (Solarex Corp., Rockville, MD (USA)). Aug 1979. Contract ET-78-C-04-5310. 187p. Dep. NTIS, PC A09/MF A01.

The purpose of this program is to demonstrate the use of a concentrating photovoltaic system to provide the energy for operating a silicon solar cell production facility, i.e., to demonstrate a solar breeder. Solarex has proposed to conduct the first real test of the solar breeder concept by building and operating a 200 kW(e) (peak) concentrating photovoltaic system based on the prototype and system design developed during Phase I. This system will provide all of the electrical and thermal energy required to operate a solar cell production line. This demonstration would be conducted at the Solarex Rockville facility, with the photovoltaic array located over the company parking lot and on an otherwise unusable flood plain. Phase I of this program included a comprehensive analysis of the application, prototype fabrication and evaluation, system design and specification, and a detailed plan for Phases II and III. A number of prototype tracking concentrator solar collectors were constructed and operated. Extensive system analysis was performed to design the Phase II system as a stand-alone power supply for a solar cell production line. Finally, a detailed system fabrication proposal for Phase II and an operation and evaluation plan for Phase III were completed. These proposals included technical, management, and cost plans for the fabrication and exercise of the proposed system.

18609 (DOE/ER—0037) **Satellite Power System (SPS) FY 79 Program Summary.** (Department of Energy, Washington, DC (USA). Office of Energy Research). Jan 1980. 208p. Dep. NTIS, PC A10/MF A01.

The Satellite Power System (SPS) program is a joint effort of the US Department of Energy (DOE) and the National Aeronautics and Space Administration (NASA). It is managed by the SPS Project Office within DOE's Office of Energy Research. SPS project organization is shown in Figure 1. The SPS Project Office was established in 1978 and is responsible for the planning, management and integration of SPS research in four areas: systems definition, environmental assessment, societal assessment, and comparative assessment. In fulfilling its responsibilities, the SPS Project Office directs research and assessment efforts to determine the feasibility of the SPS concept, funds organizations supporting the program, and disseminates information developed from project research and assessments. The objective of the SPS program is to develop an initial understanding of the technical feasibility, the economic practicality, and the social and environmental acceptability of the SPS concept. This is being accomplished through implementation of the Concept Development and Evaluation Program Plan which is scheduled for completion by the end of FY 1980. The SPS Project Office annually issues a Program Summary which describes the research undertaken during the preceding fiscal year. This Program Summary covers FY 1979. It includes work completed in FY 1977 and FY 1978 in order to give a comprehensive picture of the DOE involvement in the SPS concept development and evaluation process.

18610 (DOE/JPL/954328—13) **Development of an accelerated test design for predicting the service life of the solar array at Mead, Nebraska.** Gaines, G.B.; Thomas, R.E.; Noel, G.T.; Shilliday, T.S.; Wood, V.E.; Carmichael, D.C. (Battelle Columbus Labs., OH (USA)). 7 Jun 1979. Contract NAS--7-100-954328 . 61p. Dep. NTIS, PC A04/MF A01.

This report describes an accelerated test which is designed to predict the life of the 25-kW photovoltaic array installed near Mead, Nebraska. Emphasis is placed on the power-output degradation at the module level and on long-term degradation modes, as appropriate for life prediction of mature devices for which infant failures are few. A quantitative model for accelerating testing using multiple environmental stresses is used to develop the test design. The model accounts for the effects of thermal stress by a relation of the Arrhenius form. This relation is then corrected for the effects of nonthermal environmental stresses such as relative humidity, atmospheric pollutants, and ultraviolet radiation. The test conditions, measurements, and data analyses for the accelerated tests are presented for determining the predicted life of the modules in service at Mead. Constant-temperature, cyclic-temperature, and uv types of tests are specified, incorporating selected levels of relative humidity and chemical contamination and an imposed forward-bias current and static electric field. It is recommended that as a first step in test implementation, the model be selectively validated using identified portions of the accelerated test design.

18611 (SAND—79-7051(Vol.1)) **Transient effects from lightning. Transient electromagnetic fields from lightning discharges.** Fowles, H.; Scott, L.; Hamm, J. (Mission Research Corp., Albuquerque, NM (USA)). Jan 1980. Contract EY-76-C-04-0789. 184p. Dep. NTIS, PC A09/MF A01.

The objective of this study was to determine the effects of lightning on solar photovoltaic systems in the 100 kilowatt to 1 Megawatt power range, and to determine methods for protecting these systems from lightning. The photovoltaic systems and their lightning protection requirements are described. The statistics of lightning strokes is reviewed, and the model which predicts the electromagnetic fields and optical power density is summarized. Coupling of the electromagnetic fields to photovoltaic system elements is also discussed, and the experience of power and telephone companies with lightning transients is drawn upon. A theoretical model for predicting damage thresholds for modern terrestrial solar cells is presented. The thresholds are presented in the form of peak currents as a function of pulse width for two separate failure modes: melting of the deposited metal grid and burnout of the junction. Lightning protection techniques which are technically and economically feasible for photovoltaic systems are discussed. The techniques of shielding and terminal protection are found to be most appropriate and are discussed at length. A summary of the major conclusions of the study and recommendations for future studies are presented. (WHK)

18612 (SAND—79-7051(Vol.2)) **Transient effects from lightning. Lightning protection of solar photovoltaic arrays.** Hamm, J.M. (Mission Research Corp., Albuquerque, NM (USA)). Jan 1980. Contract EY-76-C-04-0789. 130p. Dep. NTIS, PC A07/MF A01.

Lightning return strokes to ground and K changes in intracloud discharges are characterized by surges of current along ionized conducting channels. The current gives rise to transient electric and magnetic fields which are potentially damaging to systems that may be sensitive to transient disturbances. Experimental data available in the literature is used with a simple transmission line model of the discharge current to obtain estimates of the fields produced by vertical or horizontal lightning strokes. The model treats the discharge channel as a lossless uniform transmission line driven by a source at one end. The theory of pulsed linear antennas is then directly applicable and is used to compute the fields. The time and space dependence of the current pulse are assumed known and the current travels unattenuated and at a known velocity along the channel. Reflections are ignored by assuming matched terminations at the channel end points. Field predictions based on this simple lossless transmission line model have been found to be in reasonable agreement with experimental measurements obtained at ground level. Although more rigorous models of the channel current have been investigated, the lossless case appears to provide an adequate description of the electromagnetic fields. In view of the uncertainty involved in specifying the lightning channel parameters required in the calculations, it is felt that the use of the lossless model is in keeping with the current state of knowledge of lightning phenomena. FORTRAN programs for computation of the electric and magnetic fields from vertical or horizontal channels have been prepared for use with a CDC 7600 computer. The codes are described in the Appendix. (WHK)

18613 (SERI/TR—353-361(Vol.1)) **International Photovoltaic Program Plan.** Costello, D.; Koontz, R.; Posner, D.; Heiferling, P.; Carpenter, P.; Forman, S.; Perelman, L. (Solar Energy Research Inst., Golden, CO (USA); Jet Propulsion Lab., Pasadena, CA (USA)). Dec 1979. Contract EG-77-C-01-4042. 128p. Dep. NTIS, PC A07/MF A01.

The International Photovoltaics Program Plan is in direct response to the Solar Photovoltaic Energy Research, Development, and Demonstration Act of 1978 (PL 95-590). As stated in the Act, the primary objective of the plan is to accelerate the widespread use of photovoltaic systems in international markets. Benefits which could result from increased international sales by US companies include: stabilization and expansion of the US photovoltaic industry, preparing the industry for supplying future domestic needs; contribution to the economic and social advancement of developing countries; reduced world demand for oil; and improvements in the US balance of trade. The plan outlines programs for photovoltaic demonstrations, systems developments, supplier assistance, information dissemination/purchaser assistance, and an informaion clearinghouse. Each program element includes tactical objectives and summaries of approaches. A program management office will be established to coordinate and manage the program plan. Although the US Department of Energy (DOE) had the lead responsibility for preparing and implementing the plan, numerous federal organizations and agencies (US Departments of Commerce, Justice, State, Treasury; Agency for International Development; ACTION; Export/Import Bank; Federal Trade Commission; Small Business Administration) were involved in the plan's preparation and implementation.

18614 (SERI/TR—353-361(Vol.2)) **International Photovoltaic Program Plan. Volume II. Appendices.** Costello, D.; Koontz, R.;

Posner, D.; Heiferling, P.; Carpenter, P.; Forman, S.; Perelman, L. (Solar Energy Research Inst., Golden, CO (USA); Jet Propulsion Lab., Pasadena, CA (USA)). Dec 1979. Contract EG-77-C-01-4042. 218p. Dep. NTIS, PC A10/MF A01.

This second volume of a two-part report on the International Photovoltaic Program Plan contains appendices summarizing the results of analyses conducted in preparation of the plan. These analyses include compilations of relevant statutes and existing Federal programs; strategies designed to expand the use of photovoltaics abroad; information on the domestic photovoltaic plan and its impact on the proposed international plan; perspectives on foreign competition; industry views on the international photovoltaic market and ideas about how US government actions could affect this market; international financing issues; and information on issues affecting foreign policy and developing countries.

SOLAR THERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 18556, 18609, 18796, 18904

18615 (CONF-781235—P1, pp 63) **Economic analysis of solar energy alternatives: update.** Huettner, D.A.; Taylor, B.J.; Ingene, C.A.; Horrell, J.F. (Univ. of Oklahoma, Norman). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18616 (CONF-781235—P1, pp 67) **Barriers and incentives to the commercialization of small solar thermal power systems.** Stafurik, J.W. (Resource Planning Associates, Washington, DC); Marshall, D.; Herring, D.; Barbieri, R.; Kuehn, T. 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18617 (CONF-781235—P1, pp 175-176) **New developments for future solar power plants.** Simon, M. (M.A.N. Corp., Munich, Germany). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18618 (CONF-781235—P1, pp 185-187) **Simple reciprocating expander for small solar engines.** Lobo, P.C.; Vaz, C.M. (Universidade Federal de Paraiba, Brazil). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18619 (CONF-781235—P1, pp 355-357) **Commercialization of small solar thermal electric power systems: alternatives for accelerating their adoption.** Kuehn, T.J.; Strange, D.L.P.; Nawrocki, P.M. (California Inst. of Tech., Pasadena). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18620 (CONF-781235—P1, pp 359-361) **Small solar thermal power systems.** Ferber, R.R.; Marriott, A.T.; Truscello, V. (Jet Propulsion Lab., Pasadena, CA). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18621 (CONF-781235—P1, pp 363-364) **Industrialization of small solar thermal electric power systems.** Strange, D.L.P.; Walden, P.C.; Kuehn, T.J. (Caltech Jet Propulsion Lab., Pasadena, CA). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18622 (CONF-781235—P1, pp 365-366) **Project cost goals for small power systems: solar thermal electric-utility applications.** Gurfield, R.; Davis, C. (California Inst. of Tech., Pasadena). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18623 (COO—4680-1) **Combined thermal storage pond and dry cooling tower waste heat rejection system for solar-thermal steam-electric power plants. Final report.** Guyer, E.C.; Bourne, J.G.; Brownell, D.L.; Rose, R.M. (Dynatech R/D Co., Cambridge, MA (USA)). 28 Feb 1979. Contract ET-78-C-02-4680. 125p. Dep. NTIS, PC A06/MF A01.

The thermal performance and economics of the combined thermal storage pond and dry cooling tower waste heat rejection system concept for solar-thermal steam-electric plants have been evaluated. Based on the computer simulation of the operation of southwest-sited solar-thermal plants, it has been determined that the combined pond-tower concept has significant cost and performance advantages over conventional dry cooling systems. Use of a thermal storage pond as a component of the dry cooling system allows a significant reduction in the required dry cooling heat exchange capacity and the associated parasitic power consumption. Importantly, it has been concluded that the combined pond-tower dry cooling system concept can be employed to economically maintain steam condensing temperatures at levels normally achieved with conventional evaporative cooling systems. An evaluation of alternative thermal storage pond design concepts has revealed that a stratified vertical-flow cut-and-fill reservoir with conventional membrane lining and covering would yield the best overall system performance at the least cost.

18624 (SERI/TP—313-492, pp 93-99) **Report of the technical information dissemination project: FY 80.** 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

Early commercialization of solar thermal technology depends in great part upon the identification and characterization of potential users, and the skill with which DOE tech transfer programs anticipate and satisfy their information needs. For FY 80 solar thermal TID is committed to a marketing plan which singles out the industrial sector and university faculties as target audiences most in need of characterization and cultivation during the second year of the TID/tech transfer effort. With this priority in mind, certain strategies (and activities which follow naturally from them) have been undertaken to identify the members of these two audiences, to determine the kinds of technical information needed by them, and to establish fast flowing channels which link data sources to information users.

CENTRAL RECEIVER

18625 (ATR—78(7694)-02)-1) **Analysis of photovoltaic total energy systems for single family residential applications.** Chobotov, V.; Siegel, B. (Aerospace Corp., El Segundo, CA (USA). Energy and Resources Div.). Aug 1978. Contract EY-76-C-03-1101-008. 133p. Dep. NTIS, PC A07/MF A01.

The performance and cost-effectiveness of three photovoltaic total energy system concepts designed to meet the thermal and electrical demands of a typical single family house are compared. The three photovoltaic total energy system concepts considered are: (1) All-photovoltaic systems. Passively air-cooled photovoltaic panels provide electricity to meet both electrical and thermal demands. (2) Separate-panel systems. Solar thermal panels provide thermal energy, while passively air-cooled photovoltaic panels serve the purely electric demand. (3) Combined thermal/electric panel systems. Water-cooled photovoltaic panels provide both thermal energy (transported by cooling water) and electrical energy to meet the separate thermal and electrical demands. Additional passively air-cooled photovoltaic panels are added, as required, to meet the electrical demand. The thermal demand is assumed to consist of the energy required for domestic hot water and space heating, while the electrical demand includes the energy required for baseload power (lights, appliances, etc.) plus air conditioning. An analysis procedure has been developed that permits definition of the panel area, electrical and/or thermal storage capacity, and utility backup energy level that, in combination, provide the lowest annual energy cost to the homeowner for each system concept for specified assumptions about costs and system operations. The procedure appears capable of being used to approximately any size system using solar collectors, as well as in any application where the thermal and/or electrical demand is being provided by solar energy, with utility or other conventional backup. This procedure has been used to provide results for homes located in Phoenix, Arizona, and Madison, Wisconsin, and to evaluate the effects of array and backup power costs and the desirability of selling excess electrical energy back to the utility. Procedures and results are presented and discussed. (WHK)

18626 (CONF-781235—P1, pp 179-181) **Cavity receiver design for solar heated gas turbine generating systems.** Le Grives, E. (Office National d'Etudes et de Recherches Aerospatiales, Chatillon, France). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18627 (CONF-781235—P1, pp 351-353) **Repowering with solar energy.** Curto, P.A. (MITRE Corp., McLean, VA). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18628 (COO—2839-3(Vol.1)) **Heat pipe central solar receiver. Volume I. Final technical report.** Bienert, W.B.; Wolf, D.A. (Dynatherm Corp., Cockeysville, MD (USA)). Apr 1979. Contract EY-76-C-02-2839. 116p. Dep. NTIS, PC A06/MF A01.

The objective of this project was the conceptual design of a Central Solar Receiver Gas Turbine Plant which utilizes a high temperature heat pipe receiver. Technical and economic feasibility of such a plant was to be determined and preliminary overall cost estimates obtained. The second objective was the development of the necessary heat pipe technology to meet the requirements of this receiver. A heat pipe receiver is ideally suited for heating gases to high temperatures. The heat pipes are essentially loss free thermal diffusers which accept a high solar flux and transform it to a lower flux which is compatible with heat transferred to gases. The high

flux capability reduces receiver heating surface, thereby reducing receiver heat losses. An open recuperative air cycle with a turbine inlet temperature of 816°C (1500°F) was chosen as the baseline design. This results in peak metal temperatures of about 870°C (1600°F). The receiver consists of nine modular panels which form the semicircular backwall of a cavity. Gas enters the panels at the bottom and exits from the top. Each panel carries 637 liquid metal heat pipes which are mounted at right angle to the gas flow. The evaporators of the heat pipes protrude from the flux absorbing front surface of the panels, and the finned condensors traverse the gas stream. Capital cost estimates were made for a 10 MW(e) pilot plant. The total projected costs, in mid-1978 dollars, range from $1,947 to $2,002 per electrical kilowatt. On the same basis, the cost of a water/steam solar plant is approximately 50% higher.

18629 (DOE/ET/21060—2) **Assessment of feasibility, economics, and market potential for a molten salt system at 1000°F reheat steam: feasibility, economics, and market potential.** DeRienzo, P.; Masaki, M.; Mathur, P. (Aerospace Corp., El Segundo, CA (USA)). Oct 1979. Contract AT03-76ET21060. 19p. Dep. NTIS, PC A02/MF A01.

As a result of the Advanced Central Receiver (ACR) Phase I systems studies, Martin-Marietta Corporation (MMC) developed a conceptual design employing 1050°F molten salt and a 950°F/950°F reheat turbine. This concept appears to have the potential for providing higher steam conditions leading to higher performance and wider market application. This report presents the results of a preliminary investigation of the system to determine the feasibility of providing 1000°F/1000°F steam and the impact of the required design modifications on the system performance, cost, and market potential for solar repowering. Two modified designs are investigated. In one modified design, the temperature of the molten salt is the same as in the MMC baseline design (1050°F), but the steam generators have been modified to provide 1000°F/1000°F steam. In the other modified design, the enhanced steam conditions are obtained using molten salt at a temperature of 1100°F.

18630 **Developing master controls for a central receiver solar power plant.** Darsey, D.M.; Rountree, R.C.; Sheahan, R.R.; Winarski, C.P.; Soderstrand, M.A. (Sandia Lab, Albuquerque, NM). *InTech;* **26**: No. 3, 41-45(Mar 1979).

A distributed control system, comprising conventional and computerized modules, is being developed for use in a pilot central receiver solar power plant. The configuration has the capability to gather data for evaluation as well as to provide central supervision and coordination.

18631 **Solar test facility nears completion.** *Electr. World;* **189**: No. 5, 46-48(1 Mar 1978).

The solar total-energy-system test facility (STESTF) at Sandia Laboratories in New Mexico is the first solar-thermal energy plant in the US to produce a significant amount of electricity. It consists basically of a solar-collector field, high-temperature storage tank, heat exchanger, turbine/generator system, instrumentation and control system, absorption-type air conditioner, and cooling tower. Electricity and hot water generated may provide electric power, heating, and cooling for an on-site 12,000-sq ft office building.

DISTRIBUTED COLLECTOR

18632 (CONF-781235—P1, pp 183) **Investigations of a thermal storage unit for solar power generation.** Sriramulu, V.; Ahmed, S.B.; Gupta, M.C. (Indian Inst. of Tech., Madras). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18633 (CONF-781235—P1, pp 263-264) **Flat-plate collectors and east-west oriented parabolic trough concentrators option for solar thermal power plants.** Samuel, A.A.; Shet, U.S.P.; Sriramulu, V.; Gupta, M.C. (Indian Inst. of Tech., Madras). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18634 (DOE/NASA/0061—79/1) **15 kW/sub e/ (nominal) solar thermal electric power conversion concept definition study. Steam Rankine turbine system.** Bland, T. (Sundstrand Corp., Rockford, IL (USA)). Oct 1979. Contract EX-76-A-29-1060. 69p. (NASA-CR—159589). Dep. NTIS, PC A04/MF A01.

A study was performed to identify a steam Rankine cycle power conversion system which would have an efficiency higher than that achieved by currently available steam systems, at power levels associated with point-focused solar receivers. The first task of the study was to perform parametric analyses of a single-stage turbine powered system to define optimum performance characteristics for 15 kilowatt, 60 Hz electrical output. A system design optimization computer program was generated modeling the components of the system and was used to generate families of optimum systems for different steam temperatures, where optimum refers to weight and efficiency. Similar parametric analyses in somewhat less detail were performed for a two-stage re-entry steam turbine system with reheat between stages and a single-stage organic Rankine turbine system using Toluene as the working fluid. At the maximum acceptable turbine inlet temperatures of 732°C (1350°F) for steam and 427°C (800°F) for Toluene, system efficiencies of 23.2% and 27% were obtained for single and two-stage steam respectively and 27.5% for the Toluene system, where system efficiency is defined as 60 Hertz A.C. electrical power output divided by absorbed thermal power input in the working fluid. Cost estimates were made for mass-producing the system and it was found that at very high production rates the system cost would be approximately 364 dollars/kw. The principal conclusion of the study was that relatively high steam turbine Rankine system efficiencies are achievable with good off-design performance. (WHK)

TOTAL ENERGY AND HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 18631

OCEAN THERMAL GRADIENT POWER PLANTS

18635 (CONF-781235—P1, pp 273-274) **Marine technician in the future solar power industry.** De Oliveira, A. (Miami-Dade Community Coll., FL). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18636 (CONF-781235—P1, pp 313-314) **Overview of OTEC.** Lavi, G.H. (ERDI, Inc., Pittsburgh, PA). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18637 (CONF-781235—P1, pp 315-316) **Comparative composite data on OTEC.** Sherwood, W.G. (Dept. of Energy, Washington, DC); Dunning, F.S. Jr. 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18638 (CONF-781235—P1, pp 317) **Early commercialization of OTEC plants in United States islands.** Pont, R.J. (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18639 (CONF-800210—3) **OTEC power system development and environmental impacts.** Sather, N.F. (Argonne National Lab., IL (USA)). 20 Feb 1980. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From IEEE Region 6 conference; San Diego, CA, USA (20 Feb 1980).

Ocean Thermal Energy Conversion (OTEC) is a proven solar energy technology with enormous potential as a supplier of electric power. However, before this potential can be realized there must be significant reductions in OTEC plant investment costs estimated for state-of-the-art designs. A comprehensive survey of the opportunities for reducing costs of the heat exchangers and other components of the power system of closed-cycle OTEC plants is given. These cost-reducing inventives are strongly dependent on the extent to which the environmental impacts of OTEC plants will have to be controlled. The environmental concerns associated with the deployment of OTEC plants are reviewed, and approaches to alleviating these concerns are described. Finally, the key roles of the OTEC-1 component test facility and the OTEC pilot plant planned for a 1984 start up in providing information about the critical power system development and environmental impact problems are summarized.

18640 (COO—5092-T1) **Study of integration issues to realize OTEC market potential. Third quarterly report.** (General Electric Co., Washington, DC (USA). Center for Advanced Studies). Sep 1979. Contract EW-78-C-02-5092. 64p. Dep. NTIS, PC A04/MF A01.

The specific objective of this study is to examine the commercialization of OTEC technology in the electric utility industry in the Gulf region of the United States. To accomplish this, the project staff is identifying the major issues that will arise in the integration of OTEC units into the power delivery systems in the Gulf Region. Among these issues are problems that must be resolved and barriers to be overcome. These are being identified and alternative approaches to resolving or overcoming them will be explored. This will permit the recommendation of preferred approaches to integration and these approaches will be assembled into strategies for OTEC commercialization. To accomplish this it is essential that a set of reference conditions be available against which problems and barriers, and approaches to resolving them can be measured. To provide this framework a set of assumptions relative to the OTEC systems, their competition, and deployment schedules was presented in the first quarterly report. These assumptions have been reviewed and evaluated and in some cases, found questionable. Earlier, there

were no assumptions included that described the economic conditions which would prevail from the pesent through the period in which OTEC units will be integrated into utility systems. An expanded set of assumptions is presented which we feel are more representative of conditions under which OTEC units will be integrated. The analysis of commercialization issues and licensing of OTEC plants are discussed.

18641 (DOE/CS/1076—2(Vol.A)) **Baseline design of an OTEC pilot plantship. Volume A. Detailed report.** George, J.F.; Richards, D.; Perini, L.L. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). May 1979. Contract EG-77-A-29-1076. 437p. (APL/JHU/SR—78-3A). Dep. NTIS, PC A19/MF A01.

The Applied Physics Laboratory (APL) of the Johns Hopkins University has engineered a baseline design of an Ocean Thermal Energy Conversion (OTEC) pilot plantship. The work was sponsored jointly by the Department of Energy and the US Maritime Administration of the Department of Commerce. The design, drawings, specifications, supporting calculations, and narrative documentation are available through APL for use by the Government and industry for the acquisition of a pilot OTEC system. The baseline design features a platform that is configured to produce up to 20 MW(e) (net) power, using low-cost folded-tube aluminum heat exchangers, while it grazes slowly in tropical waters where the thermal gradient is greatest and the ocean environment is least severe. The design was developed by a team of contractors whose capabilities provided a systems approach to the design process. The work is documented in three volumes. Volume A is the Detailed report, which develops the design rationale, summarizes important calculations, outlines areas for future work, and presents a study of system costs. Volumes B and C, respectively, contain the engineering drawings and specifications.

18642 (DOE/CS/1076—2(Vol.B)) **Baseline design of an OTEC pilot plantship. Volume B. Engineering drawings.** (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). May 1979. Contract EG-77-A-29-1076. 132p. (APL/JHU/SR—78-3B). Dep. NTIS, PC A07/MF A01.

Volume B is part of a three-volume report that presents a baseline engineering design of an Ocean Thermal Energy Conversion (OTEC) plantship. This volume provides the engineering drawings of the hull, cold-water pipe, ship outfitting and machinery, OTEC power system, electrical system, and folded-tube heat exchangers.

18643 (DOE/CS/1076—2(Vol.C)) **Baseline design of an OTEC pilot plantship. Volume C. Specifications.** (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). May 1979. Contract EG-77-A-29-1076. 91p. (APL/JHU/SR—78-3C). Dep. NTIS, PC A05/MF A01.

Volume C is part of a three-volume report that presents a baseline engineering design of an Ocean Thermal Energy Conversion (OTEC) plantship. This volume provides the specifications for the hull, cold-water pipe, ship outfitting and machinery, OTEC power system, electrical system, and folded-tube heat exchangers.

18644 (DOE/ET/29187—2) **System planning analysis applied to OTEC: initial cases by Florida Power Corporation. Task II report No. FC-5237-2.** (Franklin Research Center, Philadelphia, PA (USA)). Mar 1980. Contract AC02-79ET29187. 111p. Dep. NTIS, PC A06/MF A01.

The objective of the task was to exercise the FPC system planning methodology on: (1) Base Case, 10 year generation expansion plan with coal plants providing base load expansion, and (2) same, but 400 MW of OTEC substituting for coal burning units with equal resultant system reliability. OTEC inputs were based on reasonable economic projections of direct capital cost and O and M costs for first-generation large commercial plants. OTEC inputs discussed in Section 2. The Base Case conditions for FPC system planning methodology involved base load coal fueled additions during the 1980's and early 1990's. The first trial runs of the PROMOD system planning model substituted OTEC for 400 MW purchases of coal generated power during 1988-1989 and then 400 MW coal capacity thereafter. Result showed higher system reliability than Base Case runs. Reruns with greater coal fueled capacity displacement showed that OTEC could substitute for 400 MW purchases in 1988-1989 and replace the 800 MW coal unit scheduled for 1990 to yield equivalent system reliability. However, a 1995 unit would need to be moved to 1994. Production costing computer model runs were used as input to Corporate Model to examine corporate financial impact. Present value of total revenue requirements were primary indication of relative competitiveness between Base Case and OTEC. Results show present value of total revenue requirements unfavorable to OTEC as compared to coal units. The disparity was in excess of the allowable range for possible consideration.

SOLAR RADIATION UTILIZATION

REFER ALSO TO CITATION(S) 18538, 18543, 18552, 18966, 18977, 19235

18645 (CONF-781235—P1, pp 145) **Sizing solar systems using hand calculations.** McMordie, R.K. (Martin Marietta, Denver, CO). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

SPACE HEATING AND COOLING

REFER ALSO TO CITATION(S) 18735, 18736, 18768, 18780, 18985, 18986, 18988, 19001, 19234

18646 (BNL—51120) **Development of hardware simulators for tests of solar cooling/heating subsystems and systems. Phase 1. Residential subsystem hardware simulator and steady state simulation.** Auh, P.C. (Brookhaven National Lab., Upton, NY (USA)). Sep 1979. Contract EY-76-C-02-0016. 29p. Dep. NTIS, PC A03/MF A01.

The proposed hardware simulator has been successfully built at the Solar Technology Group Laboratory of BNL, and it has been operational since its construction. The hardware simulator has the following unique features: it has been incorporated with a measurement-double-checking system, it is a totally closed-loop system, it employs three separate energy storage tanks, and it has been automated to perform instantaneous data collection and reduction. With the external energy storage, all the external test conditions can be easily set up for any steady state or transient run. The simulator is described in detail with schematics and actual photographs. The steady state testing of Arkla's Solaire 36 absorption chiller has been performed. The test dealt primarily with chiller capacity or coefficient-of-performance (COP) as a function of generator hot water inlet temperature (1) with condenser cooling water inlet temperature as parameter, and (2) with evaporator chilled water outlet temperature as parameter.

18647 (BNL—51121) **Development of hardware simulators for tests of solar cooling/heating subsystems and systems. Phase II. Unsteady state hardware simulation of residential absorption chiller.** Auh, P.C. (Brookhaven National Lab., Upton, NY (USA)). Sep 1979. Contract EY-76-C-02-0016. 29p. Dep. NTIS, PC A03/MF A01.

The main work involves the experimental study to determine transient and cycling performance characteristics of an advanced solar absorption chiller. Laboratory tests of the second generation Arkla chiller (Solaire 36, model WF36), using the BNL simulator, have been performed. Chiller performance has also been measured against fast and slow cycling periods under both the conventional and modified control modes. The degree of performance improvement under the modified control mode, as a function of the cycle period and such effects on the integrated chiller performance, have been thoroughly investigated.

18648 (CONF-781235—P1, pp 27) **Mass marketing of new solar homes.** MacFadyen, D.J. (Technology + Economics, Inc., Cambridge, MA). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18649 (CONF-781235—P1, pp 29-31) **Life-cycle model for solar heating system design and economic evaluation.** Clark, J.A. (Univ. of Michigan, Ann Arbor). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18650 (CONF-781235—P1, pp 33-35) **Use of evacuated tube collectors in a medium-sized commercial application.** Yaeger, R.G. (Franklin Research Center, Philadelphia, PA); Colm, H. 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18651 (CONF-781235—P1, pp 41-43) **Analytical selection of marketable SAHP systems.** Estes, R.C.; Kahan, W. (Singer Co., Fairfield, NJ). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18652 (CONF-781235—P1, pp 73) **Life cycle costing and pay back of large scale solar heating systems.** Eckhoff, L.D. (Federal Energy Corp., Denver, CO). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18653 (CONF-781235—P1, pp 117-119) **Application of solar cooling for a school building in subtropics.** Parker, A.J. Jr.; Cassel,

D.E.; Hedden, R.E. (Mueller Associates, Inc., Baltimore, MD). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18654 (CONF-781235—P1, pp 121-123) **Hourly model for solar heating systems design and economic optimum: air system, SOLHOUSE II.** Nabozny, R.L.; Clark, J.A. (Central Solar Energy Research Corp., Detroit, MI). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18655 (CONF-781235—P1, pp 125-126) **Economic design of combined solar energy and heat pump systems.** Van Steelandt, F.; Berghmans, J. (Katholieke Universiteit Leuven, Belgium). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18656 (CONF-781235—P1, pp 127-128) **Economic performance analysis: solar assisted heat pump for heating and cooling.** Sarnicola, J.F.; Knudson, J. (McFarland-Johnson Engineers, Inc., Binghamton, NY). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18657 (CONF-781235—P1, pp 129-131) **New closed form model for designing solar heating systems.** Phillips, W.F. (Utah State Univ., Logan). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18658 (CONF-781235—P1, pp 133-135) **Solar collectors. Thermal storage (heating and cooling) US patent Trombe Michel.** Michel, J.J.P. (Architecte D.U.H., Cedex, France). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18659 (CONF-781235—P1, pp 137) **Net energy analysis of solar energy systems, heat pumps and insulation for single family houses.** Wagner, H.J. (Programmgruppe Systemforschung und Technologische Entwicklung (STE) der Kernformschungsnalage, Juelich, Germany). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18660 (CONF-781235—P1, pp 199-201) **Coefficient of performance as a method of comparing solar heating systems.** Anderson, H. (Applied Solar Technology, Inc., Beltsville, MD). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18661 (CONF-781235—P1, pp 203-205) **Performance of a solar heating system with storage and heat pump.** Stephenson, J. (Univ. of Auckland, New Zealand). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18662 (CONF-781235—P1, pp 207-209) **Costs and competitivity of solar energy for heating.** Labeau, G. (Faculte Polytechnique de Mons, Belgium). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18663 (CONF-781235—P1, pp 231) **Utilization of solar energy for cooling.** Hatami, R. (Anya-Mehr Univ. of Tech., Tehran, Iran). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18664 (CONF-781235—P1, pp 307) **Skylights, energy conservation and the S-U-N computer program.** Burkhardt, W.C. (Rohm and Hass Co., Bristol, PA). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18665 (CONF-781235—P1, pp 321) **SOLCOST: a solar systems sizing computer program.** McMordie, R.K. (Martin Marietta, Denver, CO). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18666 (CONF-791127—, pp 77-79) **Chemical heat pump/chemical energy storage systems.** Botts, T.E. (Brookhaven National Lab., Upton, NY). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

Chemical Heat Pump/Chemical Energy Storage (CHP/CES) systems offer the potential for vergy high density energy storage with negligible losses, heating coefficients of performances (COP's) greater than one, and both space heating and cooling. Using solar collector panels as the source of thermal energy, the opportunity exists to increase the solar fraction for a given collector array area with CHP/CES. In implementing CHP/CES a range of configurations of the system appear to be possible and attractive. A more fruitful program may follow if some consideration is given to the way such a system is to be laid out (e.g., does one drive the heat pump electrically when auxiliary power is required) in its commercial form. Institutional concerns become prominent at this time. Cost-benefit analysis and an improved definition of loads can lead to a better understanding of market needs. Such an understanding can enhance the desirability of CHP/CES.

18667 (CONF-791127—, pp 80-82) **Chemical heat pump based on the reaction of calcium chloride and methanol for solar heating, cooling, and storage.** Offenhartz, P.O.; Schwartz, D.; Malsberger, R.E. (EIC Corp., Newton, MA). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

A thermally activated heat pump system based on the reaction of $CaCl_2$ and CH_3OH to form solid-phase $CaCl_2.2CH_3OH$ has been developed. Preliminary experiments have been carried out on a bench-scale unit with approximately 1000 Btu storage capacity. This unit incorporates a novel finned-tube-in-container heat exchanger, which can provide low-cost salt containment, tight hermetic sealing, good mass transport of vapor to the salt, and complete isolation of the vapor and salt from the heat transfer fluid. The experiments show that an absorption rate around 10% of capacity per hour can be maintained while pumping heat up a 45°C gradient, e.g., from an evaporator at -5°C to salt bed heat transfer fluid at 40°C. Anhydrous salt can be regenerated in less than 6 h with solar collector temperatures below 140°C (CH_3OH condenser at 40°C). Projected coefficients of performance are 1.6 for heating and 0.6 for cooling, and the energy storage density is ca. 4×10^5 kJ m^{-3}. Based on these results, an engineering development test unit with 100,000 Btu storage capacity - approximately 25% of the design capacity of a residential scale unit - has been designed and constructed. Current plans call for this unit to be evaluated over the course of the next year. Tests will include standard and off-design cycling in both heating and air-conditioning modes, simulated process upsets, long-term cycling, and experimental validation of the coefficients of performance.

18668 (CONF-791127—, pp 83, 83A-83B) **Sulfuric acid and water chemical heat pump/chemical energy storage system.** Clark, E.C.; Morgan, O.M. (Rocket Research Co., Redmond, WA). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

A chemical heat pump/chemical energy storage system (CHP/CES) has been designed, fabricated, and successfully tested under US Department of Energy (DOE)/Sandia Corp. funding. This first operational chemical heat pump is a key milestone in DOE's long-term thermal energy storage goals. The sulfuric acid/water chemical heat pump is suitable for both heating and cooling with an inherent energy storage density in excess of 600 Btu/lb of diluted H_2SO_4. During Phase II, an engineering model was constructed which demonstrated an energy storage density of up to 569 Btu/lb. During Phase II-A, now complete, the engineering model was used to test high temperature closed loop cycling, reduction of evaporator/condenser coils, absorption column size, and elimination of one acid tank. Preliminary investigations of commercial-type plumbing were made. Future problems for commercialization were investigated and a survey made of applicable building codes to determine any additional system requirements which would be imposed by these regulations. A preliminary economic study based on weather tapes from Albuquerque, New Mexico determined that a CHP/CES system using solar energy input could provide heating and cooling at equivalent energy rates of $0.040/kWh including the cost of solar collectors. Phase III, funded by Brookhaven National Laboratories, is now underway. A commercial-type verification test unit (VTU) is to be designed, built, and tested. The work conducted to date since the previous contractors meeting in December 1978 plus anticipated activities for the future is described.

18669 (CONF-791127—, pp 84-88) **Metal hydride chemical heat pump.** Clinch, J.M.; Gruen, D.M.; Nelson, P.A.; Blomquist, C.A.; Horowitz, J.S.; Lamich, G.J.; Sheft, I. (Argonne National Lab., IL). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

The Argonne National Laboratory (ANL) HYCSOS Metal Hydride Chemical Heat Pump Program activities for FY 1979 are described. HYCSOS is a chemical heat pump which utilizes the heat of adsorption/desorption of hydrogen in a metal alloy for the storage and recovery of thermal energy for heating and cooling. The acronym HYCSOS refers to a hydride conversion and storage system. The HYCSOS heat pump is attractive because its design can be tailored to provide heating and/or cooling over a wide range of temperatures. The HYCSOS system can be used with a variety of heat sources such as industrial waste heat, solar energy or even a fossil fuel. The HYCSOS heat pump system can be designed for both

residential and industrial users and also for community energy systems. With regard to accomplishments, the proof of the HYCSOS system can be used with a variety of heat sources such as industrial waste heat, solar energy, or even a fossil fuel. The HYYCSOS heat pump system can be designed for both residential and industrial users and also for community energy systems. With regard to accomplishments, the proof of the HYCSOS concept has been demonstrated and the viability of a residential-size unit established. In addition, an engineering development phase is now underway. The objective of the program is to develop a residential-size HYCSOS chemical heat pump for space heating and cooling. Solar energy or waste heat can be used to operate the pump and thus eliminate or reduce fossil fuel requirements. To meet this objective, ANL has performed experimental and analytical studies of the HYCSOS system. The results of these studies are discussed. Also discussed is the proposed program plan for FY 80 and beyond.

18670 (CONF-800133—1) **Reverse absorption mode of the HYCSOS chemical heat pump with low grade (~ 30°C) thermal energy inputs.** Gruen, D.M.; Mendelsohn, M.; Sheft, I.; Lamich, G. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 23p. Dep. NTIS, PC A02/MF A01.

From Workshop on thermochemical energy storage; Stockholm, Sweden (7 Jan 1980).

An efficient and cost competitive chemical heat pump and energy conversion system driven by solar, other low grade heat sources or by fossil fuels (gas or oil), has been under development at the Argonne National Laboratory since 1975. The HYCSOS concept involves the use of two different metal hydrides with different free energies of formation enabling hydrogen to flow from one to another of the hydrides under the influence of appropriate thermal gradients. In the chemical heat pump mode, hydrogen flows between two pairs of four vessels which take the place of the generator/condenser and evaporator/absorber elements of conventional absorption refrigerators. The functions of generator/absorber and condenser/evaporator are interchanged at the end of each two minute cycle. The chemical heat pump materials are based on the AB_5 alloys which combine a remarkable ability to absorb hydrogen rapidly and reversibly at moderate pressures near ambient temperatures with a large hydrogen storage capacity. The recent development of LaNi/sub 5-x/Al/sub x/ ternary alloys has provided a versatile class of materials whose hydrogen dissociation pressures can be varied in a precisely predetermined manner by almost three orders of magnitude. With these new materials it will be possible to operate the chemical heat pumps over a wide range of preselected temperatures and pressures. The operation of the HYCSOS chemical heat pump for upgrading of low-grade (~ 30°C) thermal energy input will be stressed.

18671 (COO—4578-1) **Control of solar energy systems for heating and cooling.** Clark, E.F.; de Winter, F. (eds.). (Altas Corp., Santa Cruz, CA (USA); Boston Univ., MA (USA)). 1978. Contract EG-77-C-02-4578. 252p. (CONF-7805126—). Dep. NTIS, PC A12/MF A01.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

Forty-three papers are included. Six were abstracted previously. Separate abstracts were prepared for thirty-seven papers. (MHR)

18672 (COO—4578-1, pp 4-5) **Real world performance of components in solar heating and cooling systems.** Newton, A.B. 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

The components which make up typical solar heating and cooling systems have different performance characteristics as to loads, ambient temperature, and heat rejection temperature changes. To optimize a system or its control strategy the relationship among the following items must be understood and properly interrelated over the entire load range: profiles, storage reactions, piping and ducting, air handler response, sink temperature, ambient range, collector performance map, control strategy, local insolation and cloud patterns, and system response. These items are the main determinants of how much of the heating and cooling function can be provided by solar energy. Proper meshing of all eleven items may make it possible to reduce the area of the solar collector array by 30 to 40 percent without reducing performance as compared to an unmeshed system. A visualization is presented of the interactions of these factors, and concentrates on those items which seem to be least understood. It attempts to show how they can be utilized and controlled more effectively to increase the economic feasibility of solar heating and cooling.

18673 (COO—4578-1, pp 6-8) **Control system requirements for an air circulating solar space heating system.** Linton, E. (Contemporary Systems, Inc., Jaffrey, NY). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

The air circulating solar space heating system, which uses a stratified pebble bed thermal storage, presents a complex task for a solar system controller. A discussion of the requirements of such a control system, including function, installation, operation, maintenance, documentation, and cost requirements, and one solution to this control situation is presented.

18674 (COO—4578-1, pp 23-31) **Development of a novel controller.** Kent, T.B.; McGavin, M.J. (Solar Control Corp., Boulder, CO). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

Work on a high performance controller for solar heating and cooling applications is reviewed. This will offer adaptive control of the solar system for optimal collection and distribution while maintaining home comfort levels. Also included are: applicability to both liquid and air transport systems, and variability of off-set and flow rates. Use of microprocessor logic base was investigated for cost effectiveness. The key novelty is the adaptive aspect which reduces duty cycle when high ambient levels exist, and reduces flow rate as load demand is satisfied.

18675 (COO—4578-1, pp 32-38) **Advanced freeze protection control logic for direct circulation (draindown) systems.** Lewis, R. Jr.; Carr, J.B. (Hawthorne Industries, Inc., West Palm Beach, FL). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

Control systems for draindown systems are reviewed. Shortcomings in these control systems are categorized. Examples are given of critical situations which may be encountered with either of these systems. Similar situations are presented but using frost override freeze protection with outside ambient temperature monitor. Frost override logic used with proportional control and exercising solenoid valves is discussed. (MHR)

18676 (COO—4578-1, pp 39-50) **Stochastic predictions of solar cooling system performance for different control strategies.** Anand, D.K.; Deif, I.N.; Abarcar, R.B.; Bazques, E.O. (Univ. of Maryland, College Park). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

The performance of solar systems has previously been simulated using real as well as stochastic weather input data but with a fixed control strategy. Cooling system performance predictions are presented using real and synthetic weather for different control strategies. The study includes a diverse selection of climatic regions and is performed using a system simulation that features load calculation and storage as well as automatic controls. For several control strategies, performance indices, such as system coefficient of performance, total insolation, percent solar, and useful energy delivered using the stochastic approach are seen to be in fair agreement with real data when compared over the cooling season for the various cities. The input data necessary for simulations in a local region is reduced by using the stochastic method; hence considerable savings in system simulation result without significant loss of accuracy.

18677 (COO—4578-1, pp 51-55) **Study of pump cycling in the control of solar heating and cooling systems.** Herczfeld, P.R.; Klafter, R.D.; Fischl, R.; Orbach, A. (Drexel Univ., Philadelphia, PA). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

One of the more serious problems in the control of solar heating and cooling systems is cycling which reduces the collection efficiency and the lifetime of pumps, valves, etc. The results of an analytic study that relates cycling to various system parameters such as flow rate, sensor position, collector capacitance, length of transport system, etc., are presented. The dynamic model of the collector loop, consists of a collector subsystem with capacitance, two transport subsystems to and from the storage, and a stratified storage. The model is described in terms of four coupled, inhomogeneous partial differential equations.

18678 (COO—4578-1, pp 56-62) **Improved integration method for solar system control modeling using the TRNSYS program.** Orbach, A.; Fischl, R.; Herczfeld, P.R. (Drexel Univ., Philadelphia, PA). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

A new numerical integration method implemented in the TRNSYS solar system simulation program for control modeling is presented. This integration method has improved stability and accuracy characteristics over the current method used by the TRNSYS program in terms of its ability to handle the non-linearities, discontinuities, and rate of change of the forcing functions encountered when simulating various control strategies.

18679 (COO—4578-1, pp 64-67) **Cost effective control systems for solar heating and cooling applications.** Pejsa, J.H. (Honeywell Energy Resources Center, Minneapolis, MN). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

A pair of general computer programs SUNSIM/DYNSIM and their results are described for five major areas of control. These areas are: system actuator configuration and control, proportional versus on/off control of the collector loop, automatic thermostat night setback, storage tank control strategies relative to space heating, and storage tank management for peak load avoidance. (MHR)

18680 (COO—4578-1, pp 75-79) **Validations of solar systems simulation programs.** Winn, C.B. (Colorado State Univ., Fort Collins); Parkinson, B.W.; Duong, N. 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

A methodology is presented that has been developed for the validation of solar system simulation programs such as TRNSYS, SIMSHAC, SOLCOST, and FCHART. Also presented are results obtained from validation studies of the above-mentioned programs. The validation procedures presented represent a systematic approach and are based on clustering and statistical analyses of the residuals that are formed from the difference between simulation and observed results. Examples illustrating why the statistical analysis of the residuals is a more reliable test of program validity than an examination of plots of simulated and experimental results for a period such as a week are included.

18681 (COO—4578-1, pp 80-82) **Comparative study of on/off and proportionally controlled systems.** Lewis, R. Jr.; Carr, J.B. (Hawthorne Industries, Inc., West Palm Beach, FL). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

Two identical systems were allowed to operate, one governed by an on/off differential thermostat control and the other by a proportional control, and both being continuously monitored using a multipoint stripchart recorder. Testing was performed over a period of several days with varying sky conditions and levels of solar input. During testing, it was observed that the system equipped with the proportional control not only began circulation earlier in the day, but it also displayed less interruption of circulation during the day. (MHR)

18682 (COO—4578-1, pp 83-89) **Field test data on a comparison between proportional and on/off differential thermostats.** Schlesinger, R.J. (Rho Sigma, Inc., North Hollywood, CA). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

Some field test data are presented on a comparison that was run to compare proportional differential thermostats with hard on/off thermostats. An analytical treatment was presented previously.

18683 (COO—4578-1, pp 102-104) **Control problems experienced with installed solar systems.** Guynes, B.V. (George C. Marshall Space Flight Center, Huntsville, AL). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

Control problems encountered in field installations are summarized. The first part deals with problems and solutions for demonstration applications, and the second part deals with problems and solutions for operational test sites. Control terminology is shown in schematic form.

18684 (COO—4578-1, pp 105-111) **Solafern residential solar heating control experiences using air heating flat plate collectors.** Meyer, R. (Solafern, Ltd., Bourne, MA). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

The air heating collector uses a single, low iron glass and a textured selective foil absorber. A two-pass air duct behind the absorber carries off the heat. A solar air handler containing dampers, heat exchangers, and a blower directs air flow in three operating modes. Circulators are used to carry heat to or from the water storage system. An eight-relay electrical control circuit commands the system operating modes by processing signals from seven sensors. The most important message about the control system is that it works well as designed and the rationale which made this a good system is described.

18685 (COO—4578-1, pp 116-119) **Design and field test of a generalized, programmable control and display for solar systems.** Lantz, L.J. (Solar Environmental Engineering Co., Inc., Fort Collins, CO); Parkinson, B.W.; Winn, C.B. 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

In the past few years the Solar Environmental Engineering Company (SEEC) has been involved in the design and installation of several different types of solar systems. Many have been unique enough to require the development of specialized controls. However, the building or modifying of existing controllers for each new system was not attractive in terms of time requirements or cost effectiveness. Consequently, SEEC developed and built a generalized, programmable controller with temperature display and status indicators that could be used for a wide range of different types of systems. The device can display up to eight different system temperatures and control up to 16 devices.

18686 (COO—4578-1, pp 120-124) **Design and operating experience with a complex programmable solar house control system.** Young, G.W. (Ford, Bacon and Davis, Salt Lake City, UT). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

The first commercial solar home in the state of Utah utilizes a unique architectural and solar system design. This design involves a complete custom design of all components, including a single unit 13.8 x 2.5 meter collector, and a sophisticated miniature control unit controlling ten dampers in the forced air system. Both heating and cooling are contemplated, with automatic switchover from one to another; no effort on the part of the occupants of the home is required beyond that necessary to set the desired thermostat temperatures. An additional feature is the ability of the heating system to operate in a backup mode with the control system shut down for testing or calibration.

18687 (COO—4578-1, pp 125-129) **Control strategies for electrical peak shaving.** Lorsch, H.G.; Oswald, R.L.; Crane, R.E. (Franklin Inst. Research Labs., Philadelphia, PA). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

Reduction in peak loads imposed upon electric utilities from the electrical backup energy requirements of active solar heating or cooling systems can be achieved with the use of the thermal storage device inherent in such systems and the application of appropriate control strategies. It does not appear that the control technologies required need additional development. However, additional hardware must be installed to achieve maximum peak load reduction. The additional costs of these installations must be balanced against the operating cost reductions achieved through reduced on-peak back-up energy consumption.

18688 (COO—4578-1, pp 130-137) **Management of electrical backup demand for solar heating and cooling of buildings.** Debs, A.S. (Georgia Inst. of Tech., Atlanta). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

The widespread utilization of solar heating and cooling of buildings has positive and negative impacts on the planning and cost of production of electric power systems. The positive impact is that of favorable improvements in annual and seasonal load factors. The negative impact is that of unfavorable effects on daily load factors. By means of adequate system design and control strategies the daily effect can be turned around into an advantage. The result is an overall positive impact on the planning and operation of power systems. Methodologies and techniques for peak shaving of electrical demand by adequately designed solar systems are discussed. The generation planning problem is also formulated in the presence of solar heating and cooling systems.

18689 (COO—4578-1, pp 138-143) **Optimal control strategy for peak-load reduction applied to solar structures.** Winn, C.B.; Duong, N. (Colorado State Univ., Fort Collins). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

An optimal control strategy to reduce the amount of auxiliary energy consumption and to avoid peak-load hours for solar structures is investigated. The proposed strategy consists of three interrelated operations. First, a short-term weather forecasting model based on the Kalman filtering approach is used to get the predicted values of some important weather variables such as solar radiation, wind speed and air temperature for one day. The amount of auxiliary electric energy required to be stored to satisfy the heating load requirement for that day is then derived from the estimated amount of useful solar energy collected, the heating load, the amount of energy available in the storage tank and the expected losses by heat transfer processes. Finally, a linear programming scheme is used to determine the optimal electric energy consumption sequence and a self-tuning regulator is used to minimize the discomfort in the structure. The coordination of the above operations to make the control system adaptable to changes in hourly weather conditions or time-varying electric load and price curves is discussed. Sample simulation results are also presented.

18690 (COO—4578-1, pp 144-147) **Load management for solar systems.** Moe, M.L. (Dencor, Inc., Englewood, CO). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

The load control problem is described from the viewpoints of both utilities and customers with emphasis on demand control for residential customers. It is concluded that the use of demand controllers can increase the load factor of electrically heated homes. The

use of storage in solar heated homes to increase load factor is also feasible. (MHR)

18691 (COO—4578-1, pp 151-160) **Optimal control of active solar systems.** Winn, C.B. (Solar Environmental Engineering Co., Inc., Fort Collins, CO); Hull, D.E. III. 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

The manner in which one controls a solar heating system affects the performance of the system in two basic manners. The first manner relates to the collection of energy and the second manner relates to the distribution of energy. Considering these two mechanisms the following classifications for optimal controllers are made. Optimal controllers of the first kind are represented by those controllers that optimally supply heat to a building in a manner such that a measure of the energy supplied and the occupant discomfort is minimized. Optimal controllers of the second kind represent controllers that maximize the difference between the useful energy collected and the pumping costs associated with collecting solar energy. Optimal controllers of the third kind represent controllers that combine the collection and distribution functions. An analysis of the optimal controllers of the first, second and third kinds are included. The solution to the problem of the optimal controllers of the first and second kinds are presented. Results from the problem of the optimal problem of the third kind are presented.

18692 (COO—4578-1, pp 175-182) **Control algorithms for optimized use of storage for cooling a commercial building.** Garrard, W.L. (Univ. of Minnesota, Minneapolis); Tobias, J.R. 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

Control algorithms are examined for minimizing energy costs for heating and cooling of commercial buildings. Cooling a medium sized office building is considered. Cooling is accomplished either by using cold water directly from a chiller or by using cold water from a storage tank. Water in the storage tank is chilled and stored during periods in which electricity is available at off-peak rates. A number of policies for scheduling the use of the storage tank and chiller are examined for three typical summer days. The best policy from the standpoint of daily energy costs is determined.

18693 (COO—4578-1, pp 183-185) **Optimal control of a solar augmented heat pump system.** Blodgett, R.E.; Nebus, J.R.; Trimmer, W.S. (Singer Corporate R and D Lab., Fairfield, NJ). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

The results of a study to investigate the value of applying sophisticated controls to solar heating systems are described. A residential solar heating system utilizing a heat pump operating in the series-storage mode is considered and optimal control theory is used to derive a control strategy. The basic question addressed is how much of an improvement in efficiency can be gained, relative to a conventionally designed controller, if an unrestricted control strategy is applied in an optimal fashion. The efficiency comparison is made on the basis of the amount of auxiliary energy required to attain an acceptable level of room temperature regulation. The second-order model for the system is derived using basic energy balance techniques and four control inputs are employed overall. The optimal control inputs are determined using Pontryagin's Maximum Principle which requires solution of a two-point boundary value problem. This is solved numerically using an iterative technique.

18694 (COO—4578-1, pp 193-195) **Government role in development of microprocessor control systems for solar heating and cooling.** Hankins, J.D. (George C. Marshall Space Flight Center, Huntsville, AL). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

The government role in microprocessor controllers for solar heating and cooling is described with emphasis on contracts handled by the Marshall Space Flight Center. (MHR)

18695 (COO—4578-1, pp 196-201) **Microprocessor based optimal solar controller.** Hays, D.K.; Winn, C.B.; Johnson, G.R. (Solar Environmental Engineering Co., Inc., Fort Collins, CO). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

The development of the hardware to support the optimal control algorithm developed by Hull and Winn is described. The controller is built around a 12-bit, CMOS microprocessor, but at this point all similarity with previous microprocessor-based controllers ends. The control algorithms are highly numerically oriented and require the solution, to significant accuracy, of a number of equations which necessarily involve floating point data. First, the specific controller network, its components, and their associated problems are dealt with. Software will then be discussed, giving light to the extensive library required to execute simple tasks. Finally, a flowcharted diagram of the execution steps required will be presented.

18696 (COO—4578-1, pp 202-205) **Control applications and limitations.** Kent, T.B. (Solar Control Corp., Boulder, CO); Anderson, J.E. 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

The primary barriers to the use of microprocessors, and perhaps to the solar industry itself, are discussed. Solar energy and sophisticated total energy management control will become viable when algorithms are evolved to describe universal applications, and controllers compatible with present HVAC (Heating, Ventilating, and Air Conditioning) techniques are developed. The pricing margin must also meet the norms of the industry. Time and continual government funding will be necessary to accomplish the minimum objective: large scale energy saving through widespread use of optimized total energy management in buildings.

18697 (COO—4578-1, pp 206-209) **Data acquisition and control system for solar energy projects.** Mattes, D.A. (Andover Controls Corp., Andover, MA). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

A microprocessor based data acquisition and control system, called the SUNLOGGER has been designed to alleviate these problems. The SUNLOGGER, reduces data acquisition and control problems by providing both functions under the supervision of a single microprocessor. Data gathering is performed with an accuracy of +-0.1% and data is recorded in engineering units on magnetic tape cartridges for later pick-up or telephone access. Preliminary data reduction is done on-site to simplify later processing and to provide an instantaneous quick look at crucial information via a standard telephone and computer terminal. Building control strategies can be changed by the experimenter via telephone or automatically in response to weather, changing seasons, time of day, date, or building utilization.

18698 (COO—4578-1, pp 210-214) **Solar Energy Management System (SEMS).** Moen, R.L.; Lane, R.D. (Honeywell Inc., Minneapolis, MN). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

A first-generation Solar Energy Management System (SEMS) controller is presently under development through sponsorship of the Department of Energy. This microprocessor-based device is being developed for primary application to residential solar heating and cooling systems where performance would be enhanced by advanced energy management/load control strategies. Presently, one breadboard unit is being developed for eventual performance test evaluation. This unit consists of a wall-mounted living space System Control and Annunciator Panel (SCAP), a remote Solar Electronics Module (SEM), and a System Initialization Panel (SIP). The SCAP consists of set point controls and status readouts, featuring a digital readout display. The SEM contains the microprocessor components, output relays, and sensor input interfaces. System installation parameters for SEMS are set with the SIP, a portable plug-in device. The present program focuses upon establishing functional requirements for an integrated second-generation device expected to be developed in the early 1980's. To minimize costs to the consumer, the second-generation SEMS would rely heavily upon integrated circuit technology to incorporate microprocessor, input interface and power output switching on a single custom LSI chip. This LSI device would allow a single mass-produced design to be produced at low cost with installation-sensitive reprogrammability and to provide for total energy management/load demand control capability.

18699 (COO—4578-1, pp 217-219) **Control system for the Technology Properties Trust solar heating and well water heat pump backup system.** Zvara, J. (Aerospace Systems, Inc., Burlington, MA); Wormser, E. 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

The Technology Properties Trust (TPT) office building is a new, energy-efficient, multitenant office building located in the northwest surburbs of Boston. Construction of the three-story structure containing a gross area of 20,350 sq. ft. was completed in November 1977. The design incorporated energy conservation techniques throughout, exceeding the guidelines of ASHRAE Standard 90-75 in every respect. Provision for incorporation of a solar heating and hot water system was made in the initial design. A solar energy system for heating and domestic hot water is currently being installed with partial funding by DOE under its commercial demonstration program. Completion of the system installation, checkout, and acceptance tests is scheduled for the late summer of 1978, with the system ready for full operational use in the winter of 1978.

18700 (COO—4578-1, pp 220-231) **Three point temperature controller for condenser-side storage solar-heat pump systems.** Bourne, R.C. (Univ. of Nebraska, Lincoln). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

The UNL-LES Solar-Heat Pump Demonstration Home, completed in 1975, uses a condenser-side storage approach in the heating mode; the heat pump evaporator is located in the large volume solar collector. The concept allows the use of an inexpensive yet efficient collector as a result of low operating temperatures; and a motorized damper system permits heat extraction from outdoor air when solar input is not available. While water storage is used, it is not circulated to the collector, eliminating worries of freeze damage. With reversed operation, off-peak cooling is provided, with the heat pump operating at night in summer to chill the water storage medium. The concept, design, and initial performance of a controller designed to bias the heat pump toward more favorable operating conditions in the heating mode are described.

18701 (DOE/CS—0147A) **Solar Federal Buildings Program plan.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy). Feb 1980. 27p. Dep. NTIS, PC A03/MF A01.

The Solar Federal Buildings Program (SFBP) is a multi-year program designed to stimulate the growth and improve the efficiency of the solar industry by providing funds to Federal agencies for the design, acquisition, construction, and installation of commercially applicable solar hot water, heating, cooling, and process systems in new and existing Federal buildings. This document outlines the Program Plan to be used in implementing this major solar commercialization effort.

18702 (DOE/CS/30324—1) **Abrams Primary School passive solar design. Phase 1. Final report.** (Cobb/Adams/Benton, Inc., Birmingham, AL (USA)). Jan 1980. Contract FC02-80CS30324. 199p. Dep. NTIS, PC A09/MF A01.

The general project documentation and the design process documentation for the project are presented. The following are appended: analysis of thermal transfer and internal heat contributions to the heating and cooling loads for a typical four-classroom teaching module using bin-chart temperature data, trace simulation for the original building design, Teanet simulation of original building design for the month of January 1959, Teanet simulation of Solar 2 for the month of January 1959, incremental solar cost assessment, and diffuse radiation incident on the monitor glass. (MHR)

18703 (DOE/NASA—161392) **Solar energy system performance evaluation: seasonal report for Fern, Tunkhannock, Pennsylvania. Period covered, May 1978-April 1979.** (IBM Federal Systems Div., Huntsville, AL (USA)). Jan 1980. Contract EX-76-A-29-1037. 82p. Dep. NTIS, PC A05/MF A01.

The analysis used is based on instrumented system data monitored and collected for at least one full season of operation. The objective of the analysis is to report the long-term field performance of the installed system and to make technical contributions to the definition of techniques and requirements for solar energy system design. The solar energy system was designed to supply space heating and domestic hot water for single-family residences. The system consists of air flat plate collectors, storage tank, pumps, heat exchangers, associated plumbing, and controls.

18704 (DOE/R5/10138—1) **Primary solar heat system for winter camp. Semiannual technical progress report.** (Lake Agassiz Camp Fire Council, Moorhead, MN (USA)). 30 Nov 1979. Contract FC02-79R510138. 4p. Dep. NTIS, PC A02/MF A01.

Diagrams of the solar space heating system under construction for the Lake Agassiz Campfire Lodge in Minnesota are given. The system utilizes roof-mounter air-type flat plate collectors with rock bed storage. (WHK)

18705 (EPRI-ER—1239(Vol.1)) **Monitoring the performance of solar heated and cooled buildings. Volume 1. Data acquisition equipment for the spectrum of electric utility projects. Final report.** Armstrong, P.R. (Altas Corp., Santa Cruz, CA (USA)). Nov 1979. 76p. Dep. NTIS, PC A05/MF A01.

Electric utility projects to monitor the performance of solar heated or cooled buildings are reviewed. The range and nature of the systems monitored, the variables measured, and the monitoring equipment employed are discussed. The experiences and views of project personnel are also discussed. Based on this picture of performance monitoring activity, five classes of data acquisition are identified and described: manual readings, digital pulse recorders, microprocessor digital pulse recorders, packaged data acquisition units, and combined data acquisition/data reduction units. A procedure for selecting data loggers is presented. The procedure emphasizes compatibility of data logger signal interfacing capabilities with transducers and the interactive nature of transducer selection, data logger selection and overall project planning. Reference is made to Volume 2, Measuring Instruments: Selection, Calibration and Installation, with regard to the compatibility of transducer signals, selection of sampling rates, and the specification of data logger accuracy and noise rejection characteristics.

18706 (HUD-PDR—287(2)) **Survey of passive solar buildings.** (AIA Research Corp., Washington, DC (USA)). Feb 1979. Contract EX-76-A-29-1020. 178p. Dep. NTIS, PC A09/MF A01.

Classification and general descriptions of a variety of existing applications of passive solar design are presented. The passive systems are defined as direct gain, indirect gain, or isolated gain. Direct gain systems simply transfer solar insolation to the living space and to thermal mass. Designs utilizing this concept are described. Indirect gain systems in which thermal energy is moved to a storage mass and then to the living space include mass Trombe walls, water Trombe walls, and roof ponds. Isolated gain systems are illustrated by the thermosyphon type building and the sunspace type building; isolated gain designs move heat to a collector space to a storage mass to the living space. Diagrams and descriptions of the buildings cited are included along with a reference bibliography.

18707 (LA-UR—80-854) **Additional solar/load ratio correlations for direct gain buildings.** Wray, W.O. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-800604—2). Dep. NTIS, PC A02/MF A01.

From American section of the International Solar Energy Society conference; Phoenix, AZ, USA (2 Jun 1980).

Solar/load ratio (SLR) correlations have been developed for two new reference direct gain designs. The new reference designs are identical to the originals except that the glazing air gap has been increased from 1/4 in. to 1/2 in. and a vector average of the local hourly windspeed was used in the thermal network calculations rather than an assumed average value of 15 m.p.h. Both of these modifications are realistic and enhance the predicted performance of direct gain buildings. A comprehensive set of mass sensitivity calculations has been performed in order to provide information needed to select an appropriate set of parameters for new lightweight direct gain designs for which additional SLR correlations will be developed. Representative results are reported.

18708 (NCEI—0012) **Model solar home for demonstration and consumer studies. Final report, August 18, 1978-August 31, 1979.** Goswami, D.Y.; Klett, D.E.; Mazyck, H.; Turner, C. (North Carolina Agricultural and Technical State Univ., Greensboro (USA)). Dec 1979. 53p. NTIS, PC A04/MF A01.

The University's existing Home Management House was retrofitted for demonstration of solar heating and some other energy conservation ideas. The retrofitting included the following: active solar water heating system; attached solar greenhouse for passive space heating; in-line demand water heater; insulation of walls, floor, and attic; installation of storm windows; and covering of fireplace opening and installation of a wood stove. The solar collectors use extruded absorber material from which collectors may be fabricated by do-it-yourselfers. (MHR)

18709 (NP—24341) **Natural gas and solar energy: a step into the future.** (Ruhrgas A.G., Essen (Germany, F.R.)). Oct 1978. 38p. (In German). Dep. NTIS (US Sales Only), PC A03/MF A01.

This is a product information brochure on the sector, Solar Energy Utilization in Domestic Heating Technology. After an outline of the structure and functioning of solar collectors and the use of solar energy for water and space heating, solar collector systems of different producers are presented and explained. These collector systems are bivalent systems, as solar energy alone is not sufficient for the total energy supply of a house in the northern hemisphere. The second possibility is natural gas. The highest possible efficiency can be achieved with a combination of solar collector and gas-fired heat pump.

18710 (PB—80-801707) **Solar space heating and air conditioning. Volume 3. September 1977-September 1978 (citations from the NTIS data base). Report for September 1977-September 1978.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 99p. NTIS PC N01/MF N01.

Design, technical feasibility, performance, and economic factors pertaining to solar heating and cooling of buildings are discussed. Commercial buildings, schools, and residential buildings are covered, with emphasis on the assessment of solar heating and cooling systems for residential buildings. Included are a few abstracts of reports on solar energy as a national energy resource; solar energy research program alternatives; and social, environmental, and institutional factors affecting the feasibility of using solar energy for heating and cooling buildings. (This updated bibliography contains 90 abstracts, none of which are new entries to the previous edition.)

18711 (PB—80-801715) **Solar space heating and air conditioning. Volume 4. October 1978-October 1979 (citations from the NTIS data base). Report for October 1978-October 1979.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 235p. NTIS PC N01/MF N01.

Design, technical feasibility, performance, and economic factors pertaining to solar heating and cooling of buildings are discussed. Commercial buildings, schools, and residential buildings are covered, with emphasis on the assessment of solar heating and

cooling systems for residential buildings. Included are a few abstracts of reports on solar energy as a national energy resource; solar energy research program alternatives; and social, environmental, and institutional factors affecting the feasibility of using solar energy for heating and cooling buildings. (This updated bibliography contains 226 abstracts, all of which are new entries to the previous edition.)

18712 (PB—80-801723) **Solar space heating and air conditioning. Volume 3. September, 1977-October, 1979 (citations from the Engineering Index data base). Report for September 1977-October 1979.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 153p. NTIS PC N01/MF N01.

Studies from worldwide literature on the use of solar energy to heat and cool buildings are discussed, with emphasis on the heating and cooling of residential buildings and schools. Design, technical feasibility, economics, and performance simulation studies are cited. Abstracts pertaining to solar assisted heat pump systems and assessment of solar heated Rankine cycle cooling are included. (This updated bibliography contains 146 abstracts, 49 of which are new entries to the previous edition.)

18713 (PB—80-801731) **Passive solar space heating and cooling (citations from the NTIS data base). Report for 1964-October 1979.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 66p. NTIS PC N01/MF N01.

Design, technical feasibility, performance, and economic factors pertaining to passive solar heating and cooling of buildings are discussed. Abstracts cover trombe walls and air thermosiphon solar heating systems, comparative economics of passive and active systems, and performance simulation studies. (Contains 58 abstracts)

18714 (PB—80-801749) **Passive solar space heating and cooling (citations from the Engineering Index data base). Report for 1970-October 1979.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 50p. NTIS PC N01/MF N01.

Studies from worldwide literature on the passive solar heating and cooling of buildings are discussed. Abstracts cover design and performance simulation studies of trombe walls and air thermosiphon solar heating systems. (Contains 45 abstracts)

18715 (SIB-R—78-1979) **Heating of ventilation air using solar collectors.** Johnsson, H.; Stillesjoe, S. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1979. 37p. (In Swedish). Dep. NTIS (US Sales Only), PC A03/MF A01.

This solar system is designed for ventilation systems equipped with intake and exhaust fans. Air heated in the collector will get a temperature rise of, typically, 10°C corresponding to an efficiency of about 60%. For ventilation systems without exhaust air heat recovery the estimated energy savings amount to about 15%.

18716 (SIB-R—91-1979) **Supplying solar heat to a district heating system.** Berndtsson, L.; Nylund, J.; Udd, B.; Aaberg, M. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1979. 33p. (In Swedish). Dep. NTIS (US Sales Only), PC A03/MF A01.

A project using 200 m^2 of solar collectors to heat return water in the Stockholm district heating system is studied. 80 to 90 MWh a year could be produced this way.

18717 (SOLAR/0021—79/07) **Collector array performance report for sites of the National Solar Heating and Cooling Demonstration Program.** (International Business Machines Corp., Huntsville, AL (USA). Federal Systems Div.). Jul 1979. Contract EG-77-C-01-4049. 146p. Dep. NTIS, PC A07/MF A01.

A major goal of the National Solar Heating and Cooling Demonstration Program is to collect and analyze data which will be used to determine the thermal performance of selected solar energy systems. To meet the goals and objectives of the Demonstration Program, the National Solar Data Network (NSDN) has been developed for the Department of Energy by the Federal Systems Division of the International Business Machines Corporation. The network consists of sensors which measure key performance parameters at a selected site, a Site Data Acquisition System (SDAS), telephone transmission circuits and a Central Data Processing System (CDPS) which collects data and performs the computations required for system performance analysis. The output of the National Solar Data Network is a monthly performance report which defines the energy contribution of the solar energy system and resultant fossil fuel savings. Data for all operational solar energy systems being monitored by the National Solar Data Network are given for the month of July 1979. The following data are given for each site: (1) single-panel instantaneous efficiency curve coefficients; (2) current month instantaneous efficiency curve coefficients; (3) cumulative (through current month) instantaneous efficiency curve coefficients; (4) cumulative (through current month) second order curve coefficients; (5) daily energy gain comparisons for the current month; (6) properties of the collector transport fluid; (7) array flow rate (average for the month); (8) single-panel flow rate; (9) array temperature gain (average for the month); and (10) monthly energy gain comparisons for the most recent 12 months. (WHK)

18718 (SOLAR/0821—79/60) **Summary and analysis of construction costs of ten solar energy systems on commercial buildings.** (Mueller Associates, Inc., Baltimore, MD (USA)). 30 Sep 1978. Contract W-31-109-ENG-38. 121p. Dep. NTIS, PC A06/MF A01.

As part of the National Solar Data Program, construction cost data for ten operational and instrumented national solar energy demonstration systems on commercial buildings have been collected, analyzed and reported. Cost data were obtained during visits to the sites, discussions with system designers, construction contractors and owners, and by review of DOE vouchers. A summary and analysis of data contained in ten site-specific Solar Project Cost Reports to identify cost components and the impact of cost factors on construction costs for those ten systems are presented. An in-depth breakdown of the cost of each solar energy system and an analysis of these costs is provided. Also included is a discussion of the cost data collection methodology. Project location, construction type and net aperture collector area are provided. Bar chart illustrates the total solar energy system costs in terms of dollars per square foot of collector area. Significant variations in the total unit system cost are evident and these variations are investigated through an analysis of specific cost categories.

18719 (SOLAR/1043—79/50) **Hullco Construction Company single family dwelling, Prescott, Arizona. Solar project description.** (Boeing Co., Seattle, WA (USA)). 7 Feb 1980. Contract EX-76-A-29-1020. 51p. Dep. NTIS, PC A04/MF A01.

The Hullco Construction solar energy system is a passive space heating system for a single family residence located in Prescott, Arizona. The south-facing building is a combination greenhouse and direct gain passive system. Incident solar energy enters the building through approximately 400 ft^2 of double-glazed prefabricated Kalwall panels. Two sliding glass doors between the greenhouse and the house along with a window in the bathroom admit incident solar energy directly into the master bedroom, living room, and bath areas of the house. Collected solar energy not used to satisfy the immediate building space heating demand is stored directly in the massive walls and floors of the building or indirectly in the 670 ft^3 of two to 6 in. diameter rock storage which is located under the floor or the north half of the building. Summer overheating protection is provided by venting of the greenhouse and by both natural and artificial shading of the greenhouse glazing. Natural shading of the greenhouse is accomplished by the use of an existing tree to the southeast of the structure. Additional greenhouse shading can be provided by a redwood snow fence placed over the glazing. Nighttime venting of the building can be used to cool the energy storage masses, thus cooling the building during the day as energy generated inside the building is absorbed by the walls and floor. Auxiliary energy for space heating can be supplied by either electric radiant heat panels, or by the wood-burning stove.

18720 (SOLAR/2035—79/50) **Solar project description for Padonia Elementary School.** (Mueller Associates, Inc., Baltimore, MD (USA); Ehrenkrantz Group, New York (USA); PRC Energy Analysis Co., McLean, VA (USA)). Jul 1979. Contract EG-77-C-01-2522. 60p. Dep. NTIS, PC A04/MF A01.

The solar energy system, utilizing 3398 gross ft^2 of parabolic reflectors and 349 gross ft^2 of receiver area, supplies a portion of the space heating and cooling requirements of the 10,000 ft^2 cafetorium and administrative complex at the Padonia Elementary School in Cockeysville, Maryland. The solar energy system is a retrofit. Freeze protection is provided by a gravity draindown into the hot water storage tank. Two steel storage tanks, one for hot water and one for chilled water, are completely buried approximately 75 ft southwest of the solar mechanical room. The tanks and underground piping are insulated with a minimum of 6 in. of sprayed-on urethane foam with no outside coating, and surrounded with earth. Hot water for space heating is provided from either the collector array directly or from storage. Chilled water for space cooling is supplied either directly from an Arkla 25-ton absorption cooler or from chilled water storage. The auxiliary energy system consists of an oil-fired boiler for heating and an electrically driven mechanical chiller for cooling.

18721 (SOLAR/2068—79/60) **Solar project cost report for Columbia Gas System Service Corporation Office Building, Columbus, Ohio.** (Mueller Associates, Inc., Baltimore, MD (USA)). Aug 1979. Contract EG-77-C-01-2522. 34p. Dep. NTIS, PC A03/MF A01.

Detailed cost information is provided for the Columbia Gas System solar space heating, cooling, and service water heating project located in Columbus, Ohio. The solar energy system supplies space heating and cooling and service hot water for approximately 25,000 ft^2 of office space and stationary printing and storage in a general office building. The system was retrofitted to the building, which was constructed in 1970. The 2978 ft^2 of parabolic concentrating collectors were manufactured by Honeywell, Inc. For cooling, water is chilled by a 100-ton Arkla packaged water chiller. Solar

heated water for use in space cooling, heating, and service water is stored in a 5000 gal hot water storage tank. The construction costs are presented.

18722 (SOLAR/2070—79/50) **Solar project description for First Baptist Church, Aberdeen, South Dakota.** (PRC Energy Analysis Co., McLean, VA (USA); International Business Machines Corp., Rockville, MD (USA). Federal Systems Div.; Mueller Associates, Inc., Baltimore, MD (USA)). May 1979. Contract EG-77-A-03-1510;EG-77-C-01-2522. 55p. Dep. NTIS, PC A04/MF A01.

The solar energy system at the First Baptist Church in Aberdeen, South Dakota is described. The solar energy system was built into the new 12,350 square foot church to heat the church and to provide domestic hot water. The 1404 square foot collector array of Solaron double glazed, flat black, flat plate collectors is mounted to the roof at a tilt angle of 30° from the horizontal. Thermal energy is stored in an 1100 cubic foot rock box that is located underground beneath the church. The box is filled with 35 tons of cleaned, washed rocks ranging in size from 3/4 to 1 1/2 inches. Solar space heating is provided by either the collector array directly or by rock box. Auxiliary space heating is provided by a 1,375,000 Btu electric boiler. Domestic hot water is preheated through a coil in the collector supply duct and stored in a 120 gallon tank. Auxiliary heating of the domestic hot water is provided by a 119 gallon electric water heater.

18723 **Solar heating system.** Mummert, H.B. US Patent 4,181,118. 1 Jan 1980. Filed date 25 Feb 1977. 6p.

A climate control system is disclosed for heating and cooling a building. The system uses solar energy for its heat source and concrete blocks for its collecting and storing material. The blocks are open faced and positioned to receive the radiation directly. An insulating enclosure is restrictably positioned to expose the blocks to the sun's radiation during the day and to enclose the blocks in the evening to trap the heat for later use. The system uses both natural and forced convection currents to transfer the heat to and from the building. In a preferred embodiment, an upper compartment with a transparent roof is built above the blocks. This compartment is comparatively small and heats quickly to high temperatures. Water pipes of the building heating system can be placed in this compartment and the heated air can be routed into the building or transmitted through a duct to the bottom of the concrete blocks to heat them. The upper compartment is particularly useful in the morning because the sun strikes it first and the heat produced can be used in the house or transmitted to the blocks to begin heating them before the sun is high enough to strike them. In addition to the insulation, the invention includes secondary walls on the exposure side of the collector, comprising transparent panels in the winter and screen louvered openings in the summer. Radiation passing through the transparent panels strikes the blocks and a hot house effect is created. When the night air is relatively cool and the days are hot, the insulating enclosure can be opened at night to pass cool air into the system to lower the temperature of the blocks so they can absorb heat from the building during the day.

18724 **Triggering device responsive to energy flow and controlled solar heating system incorporating the device.** Schultz, R.T. US Patent 4,177,795. 11 Dec 1979. Filed date 11 Aug 1977. 6p.

A device, and a controlled solar heating system incorporating the device is disclosed for providing an electrical control signal responsive to the rate of flow of species of radiant energy through an area. The device includes means for providing an electrical input signal responsive to the rate of flow of the species of radiant energy, such as solar energy, and an electrical circuit for receiving the input signal and for providing a control signal in response to the input signal. Solar cells may provide the input signal to a Schmidt Trigger Circuit set to provide two control signals at predetermined rates of solar energy flow through an area. The device, incorporated into a solar heating system, may be used to control the circulation of fluid through solar heating panels.

18725 **Solid adsorption air conditioning apparatus and method.** Weil, S.A.; Rush, W.F.; Wurm, J.; Dufour, R.F. (to Inst. of Gas Tech.). US Patent 4,121,432. 24 Oct 1978. vp.

IGT's solid adsorption air-conditioning apparatus and process for cooling and heating is compact in size, particularly adapted to low-tonnage cooling capacity (about 3 tons and less), and suitable for being at least partially solar-powered and air-cooled; natural gas may be fired in the device to provide either a primary or backup heat source. The apparatus and process utilize water vapor as the refrigerant working within a hermetically sealed module. The module has opposing thermally conductive walls that are (1) internally coated with water-vapor adsorbent material and (2) thermally insulated from each other. The water-vapor working fluid is desorbed from the adsorbent on the interior of the first side by heating while removing heat from the opposing second side. The working fluid adsorbs in a condenser function at the second side and applies heat to the second side while removing heat from the first side, causing the working fluid to desorb from the second side and adsorb at the first side. The first side acts as an adsorber while the second side functions as an evaporator; recycling the thermal-condition sequence provides heating or cooling, as desired, to the conditioned space.

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

18726 (CONF-781235—P1, pp 171-173) **Solar energy for continuous industrial processes.** Mueller, K.W. (Stauffer Chemical Co., Dobbs Ferry, NY). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18727 (CONF-781235—P1, pp 377-379) **Experimentation and assessment of various solar crop driers.** Sayigh, A.A.M. (Univ. of Riyadh, Saudi Arabia). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18728 (CONF-781235—P1, pp 385-386) **Dehydration of fish using solar energy.** Ismail, M.S. (Universiti Pertanian Malaysia, Selangor). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18729 (LA-UR—80-837) **Utilization of solar thermal sources for thermochemical hydrogen production.** Bowman, M.G. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-800604—3). Dep. NTIS, PC A02/MF A01.

From American section of the International Solar Energy Society conference; Phoenix, AZ, USA (2 Jun 1980).

The utilization of high temperature solar heat for the production of electricity and/or fuels is a popular concept. However, since solar concentrator systems are expensive and solar radiation intermittent, practical utilization requires processes that exhibit high conversion efficiencies and also incorporate energy storage. The production of hydrogen fulfills the requirement for energy storage and can fulfill the requirement for efficient heat utilization if thermochemical cycles are developed where the temperature and heat requirements of the process match the heat delivery characteristics of the solar receiver system. Cycles based on solid sulfate decomposition reactions may lead to efficient utilization of solar heat at practical temperatures. Higher temperature cycles involving oxide decomposition may also become feasible.

18730 (SERI/TR—34-091) **End-use matching for solar industrial process heat. Final report.** Brown, K.C.; Hooker, D.W.; Rabl, A.; Stadjuhar, S.A.; West, R.E. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1980. Contract EG-77-C-01-4042. 235p. Dep. NTIS, PC A11/MF A01.

Because of the large energy demand of industry (37% of US demand) and the wide spectrum of temperatures at which heat is required, the industrial sector appears to be very suitable for the matching of solar thermal technology with industrial process heat (IPH) requirements. A methodology for end-use matching has been devised, complete with required data bases and an evaluation program PROSYS/ECONMAT. Six cities in the United States were selected for an analysis of solar applications to IPH. Typical process heat requirements for 70% of the industrial plants in each city were identified and evaluated in conjunction with meteorological and economic data for each site to determine lowest-cost solar systems for each application. The flexibility and scope of PROSYS/ECONMAT is shown in a variety of sensitivity studies that expand the results of the six-city analysis. Case studies of two industrial plants were performed to evaluate the end-use matching procedure; these results are reported.

WATER HEATING

REFER ALSO TO CITATION(S) 18648, 18650, 18653, 18662, 18665, 18701, 18703, 18708, 18709, 18717, 18718, 18721, 18722, 18985, 18986, 18988, 19001

18731 (CONF-781235—P1, pp 37-39) **Making solar water heating cost-effective in the colder climate.** Cosel, W.J. 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18732 (CONF-781235—P1, pp 213-216) **Performance analysis of swimming pool solar heating in Florida.** Talwar, R. (Mid-American Solar Energy Complex, Eagan, MN). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18733 (CONF-781235—P1, pp 217-222) **Solar water heating with a new approach.** Windham, J.R. (Univ. of Florida, Gainesville). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18734 (CONF-781235—P1, pp 223) **Demonstration solar hot water system.** Dwyer, L. (Chaminade High School, Hollywood, FL). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18735 (COO—4578-1, pp 9-20) **Assessment of the need for new controls.** Davis, A. (Rho Sigma, Inc., North Hollywood, CA). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

Several areas are identified where additional control development would speed commercialization of solar energy systems by increasing the performance of solar-fired absorption and solar-related heat pump systems. During the survey and evaluation performed under this contract, domestic water heating and peak load reduction were identified as areas where no additional government stimulation of control hardware development appears to be needed, but where development of algorithms would be useful. Identification of the state of the art in solar controls and reports on some controls which are nearing the market are included.

18736 (COO—4578-1, pp 21-22) **Assessment of needs for new controllers.** Kent, T.B.; McGavin, M.J. (Solar Control Corp., Boulder, CO). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

A questionnaire was devised and sent to three different groups: solar manufacturers, installers of solar equipment, and to architects and engineers. The purpose was to identify needs for new controllers and to recommend requirements for new development in the field. The contacts were made through direct mail and by indepth technical discussions with individuals in the solar field. In the direct-mail portion of the survey, questionnaires were mailed to a list of 750 individuals and firms throughout the country. One hundred were returned by the postal services because the addressees were no longer in business, responses were received from 128. In addition, personal interviews were conducted with representatives of 40 different firms in the solar field. The consensus of the survey responses indicates that present differential thermostat type controllers for domestic hot water are judged to be adequate for the most part. Some improvements are needed to simplify installation, increase reliability, and handle extreme tmperature situations. Most of those replying were not aware of the shortcomings of the commonly used controls for water and space heating. (MHR)

18737 (DOE/NASA/CR—161383) **Solar energy system performance evaluation: seasonal report for IBM System 2, Togus, Maine.** (IBM Federal Systems Div., Huntsville, AL (USA)). Jan 1980. Contract EX-76-A-29-1037. 69p. Dep. NTIS, PC A04/MF A01.

The operational and thermal performance of a variety of solar systems installed in Operational Test Sites under this program is described. The analysis used is based on instrumented system data monitored and collected for at least one full season of operation. The objective of the analysis is to report the long-term field performance of the installed system and to make technical contributions to the definition of techniques and requirements for solar energy system design. The solar energy system, SIMS Prototype System 2, was designed to supply domestic hot water to single-family residences. The system consists of flat plate collectors, silicone working fluid, storage tank, pumps, heat exchanger, controls, and associated plumbing.

18738 (HUD-PDR—407) **Installation guidelines for solar DHW systems in one- and two-family dwellings.** (Franklin Research Center, Philadelphia, PA (USA)). Apr 1979. Contract EX-76-A-29-1020. 114p. Dep. NTIS, PC A06/MF A01.

Guidelines for professional installation contractors and experienced homeowners for installing solar domestic hot water systems are provided. The guidelines assume the installer has knowledge of plumbing, wiring, roofing, carpentry, masonry, paints, glazing, and insulation materials. Instructions are provided for: start-up, system layout, and siting; roof and ground mounting procedures; transfer fluids, piping, and ductwork; insulation; pumps, valves, gauges, and expansion tanks; heat exchangers and storage tanks; safety considerations; checkout and charge-up of the system; maintenance; and an installation checklist. Consideration is also given to tools, installation programs, and minimum property standards.

18739 (SIB-R—82-1979) **Ingelstad solar heating plant at Vaexsjoe, Sweden: planning and preparing the construction work.** Finn, L. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1979. 70p. (In Swedish). Dep. NTIS (US Sales Only), PC A04/MF A01.

A solar heating plant producing half the heating and hot water needed for 52 one family houses is reported. Heat from 1300 m^2 of solar collectors will be stored in a concrete water reservoir holding 5000 m^3 at a maximum temperature of 95 C. An oil fired heat central will supply extra heating during late winter and early spring. The total cost of the project amounts to 8.14 M skr (almost 2 M US dollar).

18740 (SIB-R—100-1979) **Solar heating of water for apartment houses.** Matsson, L.O. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1979. 32p. (In Swedish). Dep. NTIS (US Sales Only), PC A03/MF A01.

A project for installing hot water system in an old building in central Stockholm is reported. Like many other old buildings in Stockholm the house does not have a central hot water system. It is estimated that by installing 100 m^2 of solar collectors about 50% of the energy for hot water consumed by the 23 apartments could be saved.

18741 (SOLAR/2028—78/50) **Solar project description for Hogate's Restaurant.** (PRC Energy Analysis Co., McLean, VA (USA)). 9 May 1978. Contract EG-77-C-01-2522. 39p. Dep. NTIS, PC A03/MF A01.

Solar energy is used to preheat process water for this 900 seat restaurant on the north bank of the Potomac River in Washington, D.C. The solar energy system was retrofitted to the building during the summer and autumn of 1977. The system utilizes 300 Sunworks collectors with a total effective aperture area of 5840 square feet. The collectors face 45° west of south at a tilt angle of 55° from the horizontal because of building constraints. The collectors are mounted in two banks, each two collectors high on a steel I-beam support structure that runs parallel to the sloped lines of the two existing mansard roofs. All collectors are piped in parallel, and balancing valves are used for flow balancing. A propylene glycol and water mixture is used in the collectors, and the fluid is pumped through two heat exchangers in series. On the other side of the heat exchangers, duplex pumps circulate water from the storage tanks and back to the heat exchangers. On demand for hot water in the restaurant, preheated water flows from the tanks to a gas-fired boiler as cold water make-up is fed to the tanks. All the pumps, heat exchangers, and controls are located in a mechanical equipment room in the penthouse at the same level as the collectors. The two 5000-gallon pressurized storage tanks are located two floors below the equipment room in a parking garage.

OTHER

REFER ALSO TO CITATION(S) 18663

18742 (CONF-781235—P1, pp 141-142) **Effect of condenser temperature on the performance of a solar refrigerator.** Venkatesh, A.; Sriramulu, V.; Gupta, M.C. (Indian Inst. of Tech., Madras). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18743 (CONF-781235—P1, pp 371) **Multieffect solar desalination system.** Moustafa, S.M.A. (Western Illinois Univ., Macomb); Brusewitz, G.H. 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18744 (CONF-781235—P1, pp 373-374) **Preheated solar water distiller: indoor simulation (I)** . Abd Rabbo, M.F.; Zahran, M.Z.; El-Metwally, E.S.; Aly, A.A.; Sakr, I.A. (Univ. of Zagazig, Cairo, Egypt). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18745 (CONF-781235—P1, pp 375) **Preheated solar water distiller: outdoor tests (II).** Abd Rabbo, M.F.; Zahran, M.Z.; El-Metwally, E.S.; Aly, A.A.; Sakr, I.A. (Univ. of Zagazig, Cairo, Egypt). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18746 **Solar powered hot air balloon.** Eshoo, F. US Patent 4,174,082. 13 Nov 1979. Filed date 15 Dec 1977. 6p.

A solar powered hot air balloon is disclosed having an envelope with an opaque portion and a transparent portion arranged so as to utilize solar heating to heat air within the envelope. The solar heating air may either be sufficient to provide the entire free lift or may be combined with air from a hot air generating system carried by a gondola supported by the envelope. The opaque portion of the envelope has a substantially black inner surface and a light reflecting outer surface with the black inner surface being positioned so as to receive a maximum amount of sunlight through the transparent portion for a given average position of the sun.

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 18514, 18543, 18592, 18633, 18645, 18650, 18709, 18781, 18906

18747 (ALO—3977-T1) **Demonstration salt gradient solar pond. Fourth semiannual progress report, November 1, 1978-June 30, 1979.** Zangrando, F.; Bryant, H.C. (New Mexico Univ., Albuquerque (USA). Dept. of Physics and Astronomy). 10 Jul 1979. Contract EG-77-S-04-3977. 149p. Dep. NTIS, PC A07/MF A01.

A thorough account is given of a solar pond study underway at the University of New Mexico since 1975. This report consists of the Ph.D. dissertation of Federica Zangrando entitled Observation and Analysis of a Full-Scale Experimental Salt Gradient Solar Pond. The stability condition for a non-constant gradient, doubly-diffusive system is derived and a prescription for the routine detection of potential instabilities is presented. Techniques for handling unstable regions are described. Conclusions so far strongly support the viability of the solar pond concept. Salt gradient ponds appear to have a very definite niche in the ecology of energy production.

18748 (ALO—4295-T2) **Development of improved insulation materials. Final technical report, September 1,1978-September 30, 1979.** Rabe, J.A.; Spells, S.; Homan, G.R.; Rasch, D.M.; Lee, C.L.; Parmele, R.C. (Dow Corning Corp., Midland, MI (USA)). Sep 1979. Contract EM-78-C-04-4295. 168p. Dep. NTIS, PC A08/MF A01.

Evaluations of three types of silicone foam, on which Dow Corning holds patent rights, for use as insulation in flat plate solar collectors. The three types of foam were: Type IA: a two part, room temperature curing foam cross-linked through identical with SiOSi identical with linkages; Type IB: a one-part, heat activated foam also crosslinked through identical with SiOSi identical with bonds; and Type II: a two-part, room temperature curing foam cross-linked with $=NCOS(CH_2)^3$ identical with linkages. A composite, in which a thin layer of Type IA foam protects a secondary layer of less expensive but thermally unstable isocyanurate foam, is also evaluated.

18749 (ALO—4296-T2) **Development of superior liquid coolants CCF-1. Final technical report, 1 September 1978-31 December 1979.** Hodges, R.M. (Dow Corning Corp., Midland, MI (USA)). 31 Dec 1979. Contract EM-78-C-04-4296. 161p. Dep. NTIS, PC A08/MF A01.

A comprehensive study of four representative commercially available heat transfer fluids being used in solar systems was undertaken to establish the most cost effective fluid over the life of the system. Criteria for making the assessment were the relative results of fluid toxicity tests, fire hazards tests, collector stagnation tests, and physical property comparison data of various fluids. The specific fluids evaluated were Dow Corning SylthermTM 444 silicone, Uniroyal PAO-LV polyalphaolefin hydrocarbon, Union Carbide Prestone II ethylene glycol/water solution and Dow Chemical Ambitrol NTC propylene glycol/water solution. Although there is no essential difference in the installed cost when comparing solar systems based on each of these fluids, there is a very large cost difference between the systems when life cycle costing is performed on the systems. The system representing propylene glycol/water is by far the most costly system followed by the system representing ethylene glycol/water due to possible failures and maintenance schedules. The Uniroyal PAO-LV polyalphaolefin system is the third most expensive system. The SylthermTM 444 silicone system is the least expensive, offering little or no potential for catastrophic failure and does not require any fluid maintenance.

18750 (ALO—5300-T2) **Low-cost solar antireflection coatings. Annual report, 24 July 1978-24 September 1979.** Lin, R.J.H.; Lee, J.C.; Zimmer, P.B. (Honeywell, Inc., Minneapolis, MN (USA). Systems and Research Center). Oct 1979. Contract EM-78-C-04-5300. 99p. Dep. NTIS, PC A05/MF A01.

Production processes for low-cost organic antireflection (AR) coating and etched AR coating on glass are being developed and improved. The etched AR coating process has been scaled-up to etch full-size glass panes but the chemical control of the etching solution remains a problem. Analytical methods including high pressure liquid chromatography (HPLC), flame excited atomic absorption, infrared spectroscopy, Coulter counter techniques, and liquid index of refraction measurements were examined for application to this process monitor and control problem. A phenomenological model for the key reaction species in the etching process is presented along with a monitor control scheme using refractive index measurements to set the initial reactant concentrations and HPLC to track in-process concentrations. The environmental durability of the organic AR coating of fused FEP-120 Teflon dispersion has been improved by the use of a hydrofluoric acid etch/silane coupling agent pretreatment. Improved coating processing techniques were developed culminating in the demonstration of scale-up feasibility for this process for glass panels up to 1 ft x 1 ft with good batch sample to sample repeatability.

18751 (ALO—5352-T1) **Evaluation of heat transfer enhancement in air-heating collectors.** Mattox, D.L. (Northrop Services, Inc., Huntsville, AL (USA)). Jun 1979. Contract EM-78-C-04-5352. 187p. Dep. NTIS, PC A09/MF A01.

The present research effort was initiated for the purpose of increasing the thermal efficiency of air heating solar collectors through identification and development of optimum design and operation criteria for solar absorber-to-air heat exchangers. Initially this effort took the form of a solar collector systems analysis to evaluate the impact of various techniques for enhancing the heat transfer between the absorber and air stream on overall thermal performance of the entire solar collector. This systems analysis resulted in the selection of solar collector designs providing ducted cooling air on the absorber shaded side as a base line. A transient heat transfer analysis of a complete solar air heating collector was used to demonstrate that an optimum absorber-to-air heat exchanger design could be provided with several interrupted fin configurations. Additional analyses were performed to establish that the maximum solar collector thermal performance to required pumping power was realized for a Reynolds number range of 1000 to 2000. This Reynolds number range was used to establish a theoretical design limit curve for maximum thermal performance versus required pumping power for all interrupted fin designs as published in the open literature. Heat and momentum transfer empirical relationships were defined for scaling the state-of-the-art high conductance fin designs identified from a compact configuration to the less compact designs needed for solar collectors.

18752 (ALO—30171-1) **Development of a low-temperature, low-cost, black liquid solar collector. Phase II. Semi-annual report, September 1, 1979-February 29, 1980.** Landstrom, D.K.; Talbert, S.G.; McGinniss, V.D. (Battelle Columbus Labs., OH (USA)). 20 Mar 1980. Contract AC04-79CS30171. 24p. Dep. NTIS, PC A02/MF A01.

The research efforts during these first 6 months of Phase II have been directed toward (1) evaluating the long-term durability of various plastic materials and solar collector designs, (2) obtaining sufficient outdoor performance data to design a full-scale demonstration of a black-liquid solar collector for a commercial application, (3) teaming with a company willing to commercialize black liquid plastic collectors, and (4) incorporating improved black liquids with the identified plastic collector designs. Besides conducting indoor weathering tests of various plastic materials, two outdoor automated test facilities have been built. One unit has been in use for about 2 winter months at Battelle in Columbus, Ohio, and the other unit is ready for testing in Phoenix, Arizona, by Ramada Energy Systems, Inc., a collector manufacturing company. Since Ramada Energy Systems has been working with extruded polycarbonate panels, Battelle has been working to date with extruded acrylic panel designs. Other potential plastics for solar collectors will be evaluated later in this program.

18753 (CONF-781235—P1, pp 47-50) **Heat pipes as solar energy collectors.** Russell, G.F. (Mann-Russell Electronics, Inc., Tacoma, WA). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18754 (CONF-781235—P1, pp 51-53) **Effective transmittance and thermal analysis of tubular solar collector cover.** Bayazitoglu, Y.; Asgarpour, S. (Rice Univ., Houston, TX). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18755 (CONF-781235—P1, pp 55) **Performance of solar flat-plate collectors.** Khalil, M.F. (Alexandria Univ., Egypt). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18756 (CONF-781235—P1, pp 57) **Multipurpose high temperature collector system with aesthetic properties: an answer for the economical use of solar energy.** Posnansky, M. (Atlantis Energy, Ltd., Bern, Switzerland). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18757 (CONF-781235—P1, pp 59) **Laminar flow heat transfer in a circular flat plate solar collector.** Khalil, M.F. (Alexandria Univ., Egypt). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18758 (CONF-781235—P1, pp 235-236) **Drainable evacuated collector with compound parabolic cusp reflector.** Frissora, J.R.; Platt, D.M. (Sunmaster Corp., Corning, NY). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18759 (CONF-781235—P1, pp 237-240) **Analysis and optimization procedures for a half circular, cylindrical concentrator.** Bordoloi, K.C.; Bynum, F.A. (Univ. of Louisville, KY). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18760 (CONF-781235—P1, pp 241-245) **Thermal analysis of heat exchanger of solar concentrator.** Abdel Aziz, M.M. (Cairo Univ., Egypt). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18761 (CONF-781235—P1, pp 247-249) **Depth reduction technique of compound parabolic concentrators.** Kumar, R.; Garg, S.B.L.; Bhardwaj, R.K. (Motilal Nehru Regional Engineering Coll., Allahabad, India). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18762 (CONF-781235—P1, pp 255) **Hybrid solar collectors.** Khan, M.I. (Univ. of Engineering and Tech., Lahore, Pakistan). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18763 (CONF-781235—P1, pp 257-258) **Effect of dissolved air on the efficiency of flat-plate solar heat collectors.** Kayalar, A.S.; Acatay, T. (Ege Univ., Izmir, Turkey). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18764 (CONF-781235—P1, pp 259-261) **Evacuated heat pipe solar collector.** Mahdjuri, F. (Philco Italiana S.p.A., Brembate Sopra, Italy). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18765 (CONF-781235—P1, pp 389-391) **Plastic reservoir surface collector.** Lobo, P.C.; Nobrega, E.G.O. (Universidade Federal da Paraiba, Brazil). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18766 (CONF-781235—P1, pp 392-393) **Coefficient of heat transfer by convection at solar collectors.** Jankovic, R. (Beotehna, Beograd, Yugoslavia). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18767 (CONF-781235—P1, pp 395) **Experiments with a non-convective model of a solar pond.** Wilkins, E. (Univ. of New Mexico, Albuquerque); Pinder, K.L. 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18768 (COO—2577-19) **Comparative performance of two types of evacuated tubular solar collectors in a residential heating and cooling system. Final report, October 1, 1977-September 30, 1978.** Loef, G.O.G.; Duff, W.S. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Sep 1979. Contract EY-76-S-02-2577. 139p. Dep. NTIS, PC A07/MF A01.

Solar House I, the first residential solar system test facility at the Colorado State University, is described. Provision was made for the removal and replacement of the various subsystems so that the facility could be utilized to evaluate other residential size solar components and systems. Two evacuated tube collectors and one flat plate collector were evaluated. The operations history, system performance, performance assessment, and comparison with model are included. (MHR)

18769 (COO—4297-2) **Corrosion protection of solar-collector heat exchangers with electrochemically deposited films. Second semi-annual report, 1 December 1978-31 May 1979.** Brummer, S.B.; Koch, V.R.; Schnaper, G.H. (EIC Corp., Newton, MA (USA)). Jul 1979. Contract EM-78-C-04-4297. 44p. Dep. NTIS, PC A03/MF A01.

A novel corrosion protection technique was demonstrated for the common solar collector metals Al, Cu, and Fe as mild steel. This involves the potentiostatic electrochemical deposition of thin, adherent polymer films on the interior of heat-exchanger tubes by application of a current in the presence of a suitable organic monomer. Polyphenylene oxide (PPO) films were anodically deposited onto Al, Cu, and Fe coupons from methanolic media. However, defects in these films afforded poor corrosion protection. Suitably functionalized PPO films have been cross-linked via Schiff base formation in a subsequent chemical step. While these chemically modified PPO films were demonstrably more resistant to ethylene glycol-H_2O media at elevated temperatures, they too were undermined by the thermal transfer medium. Cinnamaldehyde, a styrene-type monomer, has been successfully electrodeposited onto Al coupons. This process involved a constant, albeit unreferenced potential technique in which the Al is made the negative electrode. Cathodic deposition onto Al avoids passivating Al_2O_3 barrier coating formation, and is amenable to the cross-linking technique.

18770 (COO—4578-1, pp 69-74) **Optimal control of sun tracking solar collectors.** Hughes, R.O. (Jet Propulsion Lab., Pasadena, CA). 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

Using the disciplines of Modern Control Theory, an optimal tracking control for a point focusing solar concentrator is derived. By converting the tracking problem into a regulator problem with a trim rate input a very low pointing error is achieved. A representative example with a corresponding computer simulation is presented.

18771 (COO—4578-1, pp 186-192) **Optimal controllers of the second kind.** Winn, C.B. (Colorado State Univ., Fort Collins); Hull, D.E. III. 1978.

From Workshop on the control of solar energy; Hyannis, MA, USA (23 May 1978).

An analytical solution to the problem of determining the optimal flow rate through solar collectors so as to maximize the integral of the difference between the solar energy and the pumping costs incurred in collecting the solar energy has been obtained. The solution that is presented is an optimal feedback controller that is based upon measurable states of the system. The solution technique that was employed was that of the Pontryagin Maximum Principle and an analytical solution to the resulting two-point boundary value problem was obtained by means of a transformation that involved using the heat removal factor as the control. The optimal control (the mass flow rate) is then recoverable from the heat removal factor. The derivation of the optimal control law is presented. Also presented is a discussion of implementation of the optimal control law. Finally, comparisons between these results and those presented in an earlier paper in which a numerical solution was obtained are presented.

18772 (DOE/AL/10748—T1) **Survey of tracking systems and rotary joints for coolant piping. Final report, August 15, 1978-August 14, 1978.** Furaus, J.P.; Gruchalla, M.E.; Sower, G.D. (EG and G/Washington Analytical Services Center, Inc., Albuquerque, NM (USA)). 1980. Contract AC04-79AL10748. 305p. Dep. NTIS, PC A14/MF A01.

Problems were surveyed and evaluated with respect to solar tracking mechanisms and rotary joints for coolant piping. An analytical development of celestial mechanics, one- and two-axis tracking configurations and the effect of tracking accuracy versus collector efficiency are reported. Daily operational requirements and tracking modes were defined and evaluated. A literature and patent search on solar tracking technology was performed. Tracking system and control system performance specifications were determined. Alternative conceptual tracking approaches were defined and a cost and performance evaluation of a mechanical tracking concept was performed. Fluid coupling service specifications were determined. The cost and performance of several types of actuators and error detectors were evaluated with respect to solar tracking mechanisms.

18773 (DOE/CS/35364—T1) **Wind effects on collectors. Final report, October 1, 1978—October 1, 1979.** Hewitt, H.C. Jr.; Griggs, E.I. (Tennessee Technological Univ., Cookeville (USA)). 1 Nov 1979. Contract EM-78-C-04-5364. 113p. Dep. NTIS, PC A06/MF A01.

Consideration was given to modeling wind speed data and to a scheme for correlating data between two separate stations. A sensor system was developed to measure the effect of wind on collector performance. The specifications for the sensor are presented, and a discussion of the calibration of the sensor is given. Four experiments were performed to determine wind flow patterns around buildings. The velocity profile over an actual collector was also measured as a function of free stream velocity. A mathematical model for a solar collector and three experimental efforts to measure the effect of wind on collector performance are reported. (MHR)

18774 (DOE/NASA/CR—161382) **Qualification test procedures and results for Honeywell solar collector subsystem, single-family residence.** (Honeywell, Inc., Minneapolis, MN (USA). Energy Resources Center). Feb 1977. Contract EX-76-A-29-1037. 43p. Dep. NTIS, PC A03/MF A01.

The test procedures and results are described in qualifying the Honeywell solar collector subsystem. Testing began in mid-August 1976, and was concluded in late February 1977. Testing was done in the following areas: pressure, service loads, hail, solar degradation, pollutants, thermal degradation, and outgassing. Results from these tests are summarized.

18775 (GA-A—15759) **Molten salt test loop.** Schuster, J.R.; Eggers, G.H. (General Atomic Co., San Diego, CA (USA)). Jan 1980. Contract AC03-76CS30167. 13p. (CONF-7906153—1). Dep. NTIS, PC A02/MF A01.

From Advanced technology meeting on advanced solar thermal power systems; Long Beach, CA, USA (19 Jun 1979).

The objective of the Molten Salt Test Loop Project was to design, construct, and demonstrate operation of an outdoor high

temperature molten salt test facility. This facility is operational, and can now be used to evaluate materials and components, and the design features and operating procedures required for molten salt heat transport systems. The initial application of the loop was to demonstrate the feasibility of using molten salt as the heat transport medium for a high temperature distributed collector system. A commercially available eutectic salt blend is used as the heat transfer fluid. This salt has a composition of 40% $NaNO_2$, 7% $NaNO_3$, and 53% KNO_3 and is marketed under the trade name Hitec. It has a freezing (solidifying) point of 142°C (288°F) and has been satisfactorily used at temperatures as high as 594°C (1100°F). General Atomic (GA) installed a row of Fixed Mirror Solar Concentrators (FMSC's) in the loop. The system was started up and a test program conducted. Startup went smoothly, with the exception of some burned-out trace heaters. Salt temperatures as high as 571°C (1060°F) were achieved.

18776 Header for a solar energy collection system. Erb, R.A. (to Franklin Inst.). US Patent 4,178,914. 18 Dec 1979. Filed date 3 Aug 1978. 12p.

In a solar thermal energy collection system comprising at least one unitary, coextruded solar collector panel, having an upper, heat insulating region, and a lower, heat absorbing region, each region has channels extending longitudinally, adapted to contain a fluid therein, and a pair of headers, connected to the collector panel along an interface abutting the ends of the channels of the heat insulating region and the heat absorbing region, and connecting the collector panel to the remainder of the collection system. An improved header is provided, having a wall, which extends outward, initially tangentially, from a point along the interface which is substantially closest to the axial center of the header, and then along the interior of the wall of the header, forming a transitional channel which communicates with the second channels and which uniformly directs a fluid between the second channels and the central cavity defined by the header. It has an inner and outer wall, separating the cavity of the header from its exterior, and a plurality of ribs seprating the inner and outer wall from each other, to form longitudinally extending channels which serve as heat insulating channels between the exterior of the header and the fluid circulating therein.

18777 Solar energy collection system and apparatus for same utilizing latent energy storage fluid. Levy, S. US Patent 4,176,655. 4 Dec 1979. Filed date 26 Apr 1977. 8p.

A solar energy collection and utilization storage system is constructed by using a lenticulated transparent element closed at the back to form channels which are used to carry an energy storage fluid. The lenticulations are designed as light trapping surfaces so that virtually all of the energy from the sun at any time of day falling on the sheet is trapped by the lenticulations and transferred to an energy storage fluid which is in the passages formed by the lenticulations and the back cover panel. The rate of flow through the solar collector panel is controlled by a thermostatic valve element which opens the flow when the fluid reaches a predetermined temperature. The energy storage fluid is a dispersion of a crystalline polymer in a heat transfer fluid which has the capacity of storing heat by a latent heat of crystallization as well as by sensible heat. By use of a suitable polymer the energy storage fluid can store energy at a high enough temperature to produce a significant amount of shaft power utilizing a heat engine. The remainder of the system comprises a storage container, suitable fluid connecting lines, a heat exchanger to extract sensible heat, and means to circulate the fluid through the system. The combination of the flat panel collector and the efficient energy storage fluid combine to make an effective collector system which can be employed to drive a heat pump for heating and cooling or to generate electric power.

HEAT STORAGE

REFER ALSO TO CITATION(S) 18632, 18666, 18667, 18668, 18739, 18904, 18906, 19128

18778 (ANL—79-15(Ed.2)) **Design and installation manual for thermal energy storage.** Cole, R.L.; Nield, K.J.; Rohde, R.R.; Wolosewicz, R.M. (Argonne National Lab., IL (USA)). Jan 1980. Contract W-31-109-ENG-38. 381p. Dep. NTIS, PC A17/MF A01.

The purpose of this manual is to provide information on the design and installation of thermal energy storage in active solar systems. It is intended for contractors, installers, solar system designers, engineers, architects, and manufacturers who intend to enter the solar energy business. The reader should have general knowledge of how solar heating and cooling systems operate and knowledge of construction methods and building codes. Knowledge of solar analysis methods such as f-Chart, SOLCOST, DOE-1, or TRNSYS would be helpful. The information contained in the manual includes sizing storage, choosing a location for the storage device, and insulation requirements. Both air-based and liquid-based systems are covered with topics on designing rock beds, tank types, pump and fan selection, installation, costs, and operation and maintenance. Topics relevant to latent heat storage include properties of phase-change materials, sizing the storage unit, insulating the storage unit, available systems, and cost. Topics relevant to heating domestic water include safety, single- and dual-tank systems, domestic water heating with air- and liquid-based space heating systems, and stand alone domestics hot water systems. Several appendices present common problems with storage systems and their solutions, heat transfer fluid properties, economic insulation thickness, heat exchanger sizing, and sample specifications for heat exchangers, wooden rock bins, steel tanks, concrete tanks, and fiberglass-reinforced plastic tanks.

18779 (CONF-781235—P1, pp 303-304) **Role of silica in geothermal storage.** Guha, T.K. (Subsurface, Inc., Bellaire, TX); Fleniken, J.A.; Davis, K.E.; Collins, R.E. 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18780 (DOE/CS/32939—10) **Design of annual storage solar space heating systems.** Hooper, F.C.; Cook, J.D. (Toronto Univ., Ontario (Canada). Dept. of Mechanical Engineering). Nov 1979. Contract EY-76-C-02-2939. 13p. (CONF-791108—20). Dep. NTIS, PC A02/MF A01.

From 72. AICHE meeting; San Francisco, CA, USA (25 Nov 1979).

Design considerations for annual storage solar space heating systems are discussed. A simulation model for the performance of suh systems is described, and a method of classifying system configurations is proposed. It is shown that annual systems sized for unconstrained performance, with no unused collector or storage capacity, and no rejected heat, minimize solar acquisition costs. The optimal performance corresponds to the condition where the marginal storage-to-collector sizing ratio is equal to the corresponding marginal cost ratio.

18781 (SAN—1238-1) **Investigation of methods to transfer heat from solar liquid-heating collectors to heat storage tanks. Final report.** Horel, J.D.; de Winter, F. (Altas Corp., Santa Cruz, CA (USA)). 20 Apr 1978. Contract EY-76-C-03-1238. 265p. Dep. NTIS, PC A12/MF A01.

A study was made of the methods available to transfer heat from the collector to the water storage tank in water heating systems. In counterflow heat exchangers used in double loop water heating systems, it was found to be more important to use a high water flowrate than a high heat transfer fluid flowrate. It was earlier thought to be best to have matched WC/sub p/ (mass flowrate-specific heat) products in the loops. It was shown in this study that the water WC/sub p/ product should be about twice as large as that of the heat transfer fluid. It was found that neither the heat exchanger type nor the size was very critical, so that very simple criteria were adequate in determining optimum heat exchanger size. It was found that there is a definite system size below which one should use a traced tank or a coil in a tank. Equations and optimization criteria were developed for traced tanks or tanks with coils. At present, there is no quantitative understanding of liquid to liquid (direct contact) heat exchangers, though they are clearly quite effective. Draindown systems are discussed, and several appendices are included on heat transfer and other characteristics of fluid and of equipment.

GEOTHERMAL ENERGY

RESOURCE STATUS AND ASSESSMENT

USA

18782 (DOE/RA—0049) **Geothermal Progress Monitor Report No. 2, January/February 1980.** (Mitre Corp., McLean, VA (USA)). 1980. Contract EG-77-C-01-4014. 60p. Dep. NTIS, PC A04/MF A01.

Progress is reviewed in the following aspects of the program: electrical uses, direct-heat uses; leases; outreach and technical assistance; general activities; legal, institutional, and regulatory activities; and reports and publications. (MHR)

GEOLOGY, HYDROLOGY, AND GEOTHERMAL SYSTEMS

18783 (LBL—9093) **State-of-the-art review of geothermal reservoir modelling.** Pinder, G.F. (California Univ., Berkeley (USA).

Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 151p. (GSRMP—5). Dep. NTIS, PC A08/MF A01.

The state-of-the-art in geothermal reservoir modelling is summarized and evaluated. Only those models which have been developed exclusively for geothermal simulation are considered. Attention is focused primarily on the two and three dimensional distributed parameter models. The general porous flow theory is formulated. For each model, the governing equations, method of approximation, treatment of the convection term, treatment of the nonlinear coefficients, solution of the resulting algebraic equations, and representation of the well-bore are presented. Example problems that have been treated are discussed briefly. (MHR)

USA

18784 (GRI—78/0035) **Visual kerogen and vitrinite reflectance analyses of the Pleasant Bayou No. 1 Well, Brazoria Co., Texas.** (Geo-Strat, Inc., Houston, TX (USA)). Sep 1979. 45p. NTIS, PC A03/MF A01.

Based on the visual kerogen analyses, the Pleasant Bayou No. 1 Well can be subdivided into six zones and nine sub zones. The stratigraphic section ranges from immature at 2,894 feet to marginally mature at 16,500 feet. From 2,894 to 5,360 feet the organic matter suite is primarily an amorphous spore-pollen assemblage with secondary amounts of vitrinite. Below 6,080 feet the kerogenaceous debris is generally of a vitrinite, plant tissue, spore-pollen mixture with very little amorphous debris. Loss-of-circulation material, indicating drilling problems, is particularly abundant in cutting samples from 9,740 to 10,820 feet. There is a significant jump in the thermal maturation index, T.A.I., at the T-3 seismic horizon between 11,180 and 11,600 feet. As a result of the overall thermal immaturity and due to only fairquality organic matter, one can expect noncommercial accumulations of biogenic methane and/or wet gas.

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

GEOPHYSICAL TECHNIQUES AND SURVEYS

18785 (CONF-7804163—(Vol.3), pp 1679-1686) **Infrared remote sensing on geothermal areas by helicopter.** Sekioka, M. (Inst. of Meteorology, Yokosuka, Japan); Yuhara, K. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A technique is developed to determine surface temperature distributions by using a helicopter-borne infrared thermographic instrument, the Canon CT-5B Thermocamera, giving thermal images of television type. Making a helicopter with an open hatch on its floor, through which a thermal images are photographed, to hover over the target area, the temperature distributions with high resolution can be obtained in projection on a horizontal plane. The two experimental surveys were performed for several subregions of an active volcanic island, Satsuma-Iwojima Island, Kagoshima, Japan. In the first survey, an attempt to print out digitally the ratio of areas between each adjacent isotherm on the isothermal image is sufficiently carried out with an isothermal area processor. A method converting the isothermal pattern of geothermal fields to a distribution of heat discharge will be applied to such a ratio of areas of isothermal patterns thus obtained in the near future. In the second one, effects of atmospheric absorption and emission between the sensor of the Thermocamera and the target area are evaluated using a newly developed helicopter-borne radiosonde system to correct the surface temperatures measured by the Thermocamera.

18786 (DOE/ET/28422—1) **Deep electrical studies on the Snake River Plain. Final report.** (Colorado Univ., Boulder (USA)). 1979. Contract AS07-78ET28422. 72p. Dep. NTIS, PC A04/MF A01.

Nine magnetometers were operated in south central Idaho to record small variations in the Earth's magnetic field. Each magnetometer recorded three components of the field, X(positive increase to magnetic north), Y(positive increase to magnetic east), and Z(positive increase downward). Persistent correlations between these components were used to detect areas of unusually high electrical conductivity near each station.

18787 (PB—296081) **Telluric sounding and mapping in the vicinity of the Salton Sea Geothermal Area, Imperial Valley, California. Master's thesis.** Humphreys, E.D. (California Univ., Riverside (USA). Inst. of Geophysics and Planetary Physics). Jun 1978. 127p. NTIS, PC A07/MF A01.

A telluric survey was conducted in the vicinity of the North Brawley and Salton Sea Geothermal Fields south of California's Salton Sea. The telluric signals were recorded at forty-two stations over a broad range of frequencies and analyzed with cascaded R C digital filters at nine nominal periods ranging from 40 seconds to 1667 seconds. At each nominal period the transformation coefficients relating the telluric signal between the base and roving stations were determined by the least-squares method. The reduced data are presented as J contour maps and polarization ellipse maps at each of the periods analyzed, and as J vs. period graphs for each station. The longitudinal resistivity value of the sedimentary sequence and its underlying seismic basement was determined for each station with reference to a surface D.C. resistivity survey and the seismically determined depth to the basement.

EXPLORATORY DRILLING AND WELL LOGGING

REFER ALSO TO CITATION(S) 18795

18788 **Method of preparing high-temperature-stable thin-film resistors.** Raymond, L.S. US Patent Application 027,439. [nd]. 10p.

A method of preparing composite, high-temperature-stable, thin-film resistors by chemical vapor deposition is disclosed. The resistor film of tungsten-silicon is formed from gaseous decomposable compounds of tungsten and silicon. The bulk resistivity of the film can be controlled and reproduced and the temperature coefficient of resistivity can be controlled over a range of values by process parameter variation.

18789 **Cure-in-place process for seals.** Hirasuna, A.R. US Patent Application 022,896. [nd]. 12p.

A cure-in-place process which allows a rubber seal element to be deformed to its service configuration before it is cross-linked and, hence, is a plastic and does not build up internal stress as a result of the deformation. This provides maximum residual strength to resist the differential pressure. Furthermore, the process allows use of high modulus formulations of the rubber seal element which would otherwise crack if cured and then deformed to its service configuration, resulting in a seal which has better gap bridging capability. Basically, the process involves positioning an uncured seal element in place, deforming it to its service configuration, heating the seal element, curing it in place, and then fully seating the seal.

18790 **Electromechanical solar tracking apparatus.** Stromberg, R.P. US Patent Application 030,806. [nd]. 12p.

The invention relates to an electromechanical solar tracking device which tracks the position of the sun using paired, partially-shaded bimetallic elements.

18791 (ALO—5391-T2) **Development of an acoustic sensor for a geothermal borehole televiewer.** Wonn, J.W. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Labs.). Mar 1979. Contract ET-76-C-04-5391. 268p. Dep. NTIS, PC A12/MF A01.

The objective of this project is to upgrade acoustic sensor technology such that appropriate well logging instruments can be made to operate under the hostile environment conditions anticipated in geothermal resource exploration and evaluation. The Borehole Televiewer (BHTV) was selected as the vehicle for this sensor improvement work, primarily because of its demonstrated ability to detect and characterize fractures under sub-geothermal conditions. The work done toward providing an improved sensor for the televiewer is described. An experimental sensor concept was devised, incorporating a thin metal acoustic window, an improved, high-temperature internal coupling fluid, and thermally resistant sensor internals. During an autoclave test, it was successfully demonstrated that the resulting experimental sensor design concept provides the basic target detection and characterization functions required of a fracture mapping, Borehole Televiewer under simulated geothermal conditions. In particular, the experimental sensor remained operational at 275°C and 7000 psi.

18792 (DOE/ET/27099—1) **Geothermal reservoir assessment case study, Northern Basin and Range Province. Final Report, 1 October 1978-30 September 1979.** (Phillips Petroleum Co., Salt Lake City, UT (USA). Geothermal Operations). Oct 1979. Contract ET-78-C-08-1592. 123p. Dep. NTIS, PC A06/MF A01.

Campbell E No. 2 well in the Humboldt House geothermal field in central Pershing County, Nevada was drilled to a depth of 8061 ft in order to confirm the existence of a commercial reservoir. This well offsets the field discovery well which was drilled in 1977 and completed to a depth of only 1835 ft. Desert Peak B-23-1 well was likewise drilled in order to help evaluate a previously discovered geothermal field located in northwestern Churchill County, Nevada. The Desert Peak B-23-1 well was drilled to a depth of 9641 ft as compared to the deepest of three earlier wells drilled to 7662 ft. The drilling and completion of both these wells are described, including the daily drilling reports, drill bit records, descriptions of the casing and cementing programs, drilling fluid descriptions including methods of combating lost circulation, wellhead equipment descriptions, and logging programs.

18793 (ORO—4937-T1) **Geopressured-geothermal test of the EDNA Delcambre No. 1 well, Tigre Lagoon Field, Vermilion Parish, Louisiana: analysis of water an dissolved natural gas. Final report.**

Hankins, B.E.; Karkalits, O.C. (McNeese State Univ., Lake Charles, LA (USA)). Sep 1978. Contract EY-76-S-05-4937. 156p. Dep. NTIS, PC A08/MF A01.

The Edna Delcambre et al. No. 1 gas well, shut-in since June 1975, was made available for the project. Two geopressured sand-bed aquifers were tested: sand No. 3 at a depth of 12,900 feet and sand No. 1 at a depth of 12,600 feet. Each aquifer was subjected to flow tests which lasted approximately three weeks in each case. Water samples were obtained during flow testing of the two geopressured aquifers. The water contained 11.3 to 13.3% dissolved solids. Several radioactive species were measured. Radium-226 was found to be approximately 10 times more concentrated than the average amount observed in surface waters. No appreciable amount of heavy metals was detected. Recombination studies at bottom-hole conditions indicate the solubility of natural gas per barrel of water to be about 24 SCF. The methane content was 93 to 95%, and the gas had a heating value in the range of 1020 to 1070 Btu/cu.ft. During the flow tests, the gas/water ratio at the well-head was observed to be 45 to 88 SCF/Bbl water produced. (MHR)

LEGAL AND INSTITUTIONAL ASPECTS

18794 (DOE/ET—0102) **Solar, Geothermal, Electric and Storage Systems Program Summary Document, FY 1980.** (Department of Energy, Washington, DC (USA). Office of Energy Technology). Jul 1979. 37p. Dep. NTIS, PC A16/MF A01.

Current and planned programs in solar technology, geothermal energy, electric energy systems, and energy storage systems are covered. After national energy policy with respect to these programs is introduced, the program structure, FY 1980 budget request, strategies, and management are identified. For each energy technology program, activity areas are described and their status outlined. Program aspects which crosscut all energy technologies (e.g., regional activities, commercialization, environmental and socioeconomic aspects, small and minority business utilization, and international programs) are described. (MHR)

ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL

REFER ALSO TO CITATION(S) 19295, 19296, 19318

18795 (LBL—8616) **Instruments for subsurface monitoring of geothermal subsidence.** O'Rourke, J.E.; Ranson, B.B. (Woodward-Clyde Consultants, San Francisco, CA (USA)). Jul 1979. Contract W-7405-ENG-48. 135p. (GSRMP—2). Dep. NTIS, PC A07/MF A01.

The requirements for a subsurface geothermal subsidence instrument were reviewed. Available instruments for monitoring subsurface displacements, both vertical and horizontal, were studied and the most capable instruments identified. Techniques and materials for improving existing or developing new instruments were evaluated. Elements of sensor and signal technology with potential for high temperature monitoring of subsidence were identified. Drawing from these studies, methods to adapt production wells for monitoring were proposed and several new instrumentation systems were conceptually designed. Finally, four instrumentation systems were selected for future development. These systems are: triple sensor induction sensor probe (with casing collar markers); triple sensor gamma ray detector probe (with radioactive markers); triple sensor reed switch probe (with magnet markers); and triple sensor oscillator-type magnet detector probe (with magnet markers). All are designed for use in well casing incorporating slip couplings or bellows sections, although the gamma ray detector probe may also be used in unlined holes. These systems all measure vertical moement. Instruments to measure horizontal displacement due to geothermal subsidence were studied and the required instrument performance was judged to be beyond the state-of-the-art. Thus, no conceptual designs for instruments to monitor horizontal movement are included.

GEOTHERMAL POWER PLANTS

18796 (SAN—1101-14/1) **Assessment of solar-geothermal hybrid system concepts.** Mathur, P.N. (Aerospace Corp., El Segundo, CA (USA). Energy and Resources Div.). 15 Mar 1979. Contract EY-76-C-03-1101-014. 47p. (ATR—79(7773-01)-2). Dep. NTIS, PC A03/MF A01.

Studies were conducted to assess the technical and economic merits and limitations of advanced solar-geothermal hybrid electric power plant concepts. Geothermal resource characteristics and technologies were reviewed to determine the best possible ways of combining solar and geothermal technologies into a hybrid operation. Potential hybrid system concepts are defined and their performance, resource usage, and economics are assessed relative to the individual solar and geothermal resource development techniques. Key results are presented.

POWER PLANT SYSTEMS AND COMPONENTS

18797 (COO—4051-44) **Compound hybrid geothermal-fossil power plants: thermodynamic analyses and site-specific applications.** DiPippo, R.; Avelar, E.M. (Brown Univ., Providence, RI (USA). Div. of Engineering; Southeastern Massachusetts Univ., North Dartmouth (USA)). Jun 1979. Contract EY-76-S-02-4051. 85p. Dep. NTIS, PC A05/MF A01.

The analysis of hybrid fossil-geothermal power plants is extended to compound hybrid systems which combine the features of previously analyzed systems: the geothermal-preheat and the fossil-superheat systems. Compound systems of the one- and two-stage type are considered. A compilation of working formulae from earlier studies is included for completeness. Results are given for parametric analyses of compound hybrid plants. System performance was determined for wellhead conditions of 150, 200, and 250°C, and for steam fractions of 10, 20, 30, and 40%. For two-stage systems an additional cycle variable, the hot water flash fraction, was varied from 0 to 100% in increments of 25%. From the viewpoint of thermodynamics, compound hybrid plants are superior to individual all-geothermal and all-fossil plants, and are shown to have certain advantages over basic geothermal-preheat and fossil-superheat hybrid plants. The flexibility of compound hybrid systems is illustrated by showing how such plants might be used at six geothermal sites in the western United States. The question of the optimum match between the energy resources and the power plant is addressed, and an analysis given for a hypothetical geothermal resource.

18798 (SAN—1137-13) **Geothermal Loop Experimental Facility. Quarterly report, October-December 1978.** Anastas, G.; Bischoff, W.S.; Bishop, H.K. (San Diego Gas and Electric Co., CA (USA)). Jan 1979. Contract EY-76-C-03-1137. 164p. Dep. NTIS, PC A07/MF A01.

The Geothermal Loop Experimental Facility (GLEF) was modified in April 1978 from a four stage flash/binary process to a two stage cycle for the extraction of energy from a high temperature, high salinity, liquid-dominated resource. The overhaul and cleaning during October and pigging problems which led to a limited shutdown in December are discussed. Reservoir assessment, including production and injection wells, are discussed. Results of tests that were accomplished are included. Laboratory data obtained for steam, brine, binary and cooling water, and scale are indicated. Any equipment that required repairs or modifications to equipment and the clarifier/media filter are discussed. The status of the feasibility and surge studies is covered. (MHR)

GEOTHERMAL ENGINEERING

CORROSION, SCALING, AND MATERIALS DEVELOPMENT

REFER ALSO TO CITATION(S) 18798, 18802

18799 (UCRL—84222) **Progress and future directions in chemical methods for the control of scale at the Salton Sea Geothermal Field.** Harrar, J.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Apr 1980. Contract W-7405-ENG-48. 6p. (CONF-800437—1). Dep. NTIS, PC A02/MF A01.

From Workshop on scale control and related topics; Los Alamos, NM, USA (16 Apr 1980).

Using a pilot-sized brine handling system at the Salton Sea Geothermal Field, a series of field tests have been conducted in which various chemical compounds were examined as possible scale control agents. Results of these tests are mentioned with reference to publications on them. (MHR)

GEOTHERMAL RESERVOIR AND WELL PERFORMANCE

REFER ALSO TO CITATION(S) 18798

18800 **Geothermal energy pump monitor and telemetric system.** Kent, W.H.; Nardi, A.P. (to Sperry Rand Corp.). US Patent 4,181,468. 1 Jan 1980. Filed date 9 Mar 1978. 14p.

The operation of a geothermal well power-generation-system is monitored by sensor, communication, and performance monitoring equipment normally associated integrally with the operating power generation system. Sensors detect magnitudes of well water temperature, of water pressure below and above the pump, and of other parameters of interest deep in the well. This data is transmitted by multiplex communication via a novel two-wire line telemetric system to receiver and utilization means at the earth's surface. Power for

excitation of deep well monitor units is supplied from the earth's surface also by the two-wire telemetric system. A configuration involving a mechanically separable transformer disposed serially within the two-wire line aids installation of the monitor system and its removal in the rare event that it is required to remove the entire pump from its operating deep well site.

DIRECT ENERGY UTILIZATION

18801 **Geothermal home construction.** Holman, W.P. US Patent 4,176,788. 4 Dec 1979. Filed date 12 Apr 1978. 10p.

A method is disclosed for constructing structures to minimize the amount of fuel necessary to heat the structure during winter months. The structure of this invention maximizes the heat obtainable from the earth at depths substantially below the frostline by providing a basement having a relatively thin floor of conducting or noninsulating material and walls with a maximum of reasonable insulation both in the basement level and in the living-level first floor of the structure. Grids are provided adjacent walls and below windows and doors at the first floor level whereby cold air within the house will drop to the basement. The external walls are of standard construction with maximum insulation to protect against heat loss from within the structure. The basement floor adjacent the walls may be insulated if desired. The structure consists of one or more floors over an excavated basement, the basement being at a depth sufficiently below the frostline so that the temperature of the earth or the geothermal heat will be relatively constant. In addition the walls are preferably insulated and the ceiling over the first floor contains insulation also.

GEOTHERMAL DATA AND THEORY

PROPERTIES OF AQUEOUS SOLUTIONS

18802 (ORNL/TM—7117) **Kinetics of silica deposition from simulated geothermal brines.** Bohlmann, E.G.; Mesmer, R.E.; Berlinski, P. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 45p. Dep. NTIS, PC A03/MF A01.

Supersaturated brines were passed through columns packed with several forms of silica (crystalline α quartz, polycrystalline α quartz, and porous Vycor). Also, silica deposition on ThO_2 microspheres and titanium powder was studied under controlled conditions of supersaturation, pH, temperature, and salinity. The residence time was varied by adjustments of flow rate and column length. The silica contents of the input and effluent solutions were determined colorimetrically by a molybdate method which does not include polymers without special pretreatment. Essentially identical deposition behavior was observed once the substrate was thoroughly coated with amorphous silica and the BET surface area of the coated particles was taken into account. The reaction rate is not diffusion limited in the columns. The silica deposition is a function of the monomeric $Si(OH)_4$ concentration in the brine. The deposition on all surfaces examined was spontaneously nucleated. The dependence on the supersaturation concentration, hydroxide ion concentration, surface area, temperature and salinity were examined. Fluoride was shown to have no effect at pH 5.94 and low salinity. The empirical rate law which describes the data in 1 m NaCl in the pH range 5-7 and temperatures from 60 to 120°C is given.

ROCK-WATER-GAS INTERACTIONS

REFER ALSO TO CITATION(S) 19726

TIDAL POWER

18803 (PB—295876) **Renewable ocean energy sources. Part II. Working papers: ocean winds, currents, waves, tides and salinity gradients.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Mar 1979. 153p. NTIS, PC A08/MF A01.

The six renewable ocean energy systems receiving Federal research support at present are: Ocean Thermal Energy Conversion (OTEC), tides, ocean winds, waves, currents, and salinity gradients. This report provides detailed analyses and descriptions of five of the six technologies. It covers the subjects: (a)winds, currents and waves; (b)tides; and (c)salinity gradients.

WAVE ENERGY CONVERTERS

REFER ALSO TO CITATION(S) 18803

WIND ENERGY

REFER ALSO TO CITATION(S) 18803

18804 (PB—295842) **The New Mexico wind energy resource. Technical report.** Barnett, K.M. (New Mexico State Univ., Las Cruces (USA). New Mexico Energy Inst.). Nov 1977. 117p. NTIS, PC A06/MF A01.

This report presents New Mexico wind information and the effects of seasons, terrain, and equipment height on wind energy. Steps in planning and installing common wind energy systems are reviewed and diagrammed. Present wind use in New Mexico and the activities in the U.S. to increase use of wind energy are also reviewed.

AVAILABILITY (CLIMATOLOGY)

REFER ALSO TO CITATION(S) 18808, 18809

18805 (ATR—78(7598)-1) **Electric utility application of wind energy conversion systems on the island of Oahu.** Lindley, C.A.; Melton, W.C. (Aerospace Corp., El Segundo, CA (USA). Energy and Resources Div.). 23 Feb 1979. Contract EX-76-C-01-2439. 48p. Dep. NTIS, PC A04/MF A01.

The objective of this study was to assess the potential for the application of Wind Energy Conversion Systems (a field of interconnected WTGs denoted in this report by the acronym WECS) in a specific utility contest to gain advance information concerning their economic feasibility; their optional problems; the criteria and procedures for site selection; environmental impacts; legal, social, and other problems; and the balance of cost and benefits from the point of view of the consumer and the utility. This study addresses the circumstances of the Hawaiian Electric Company operations onthe Island of Oahu.

18806 (PNL-SA—7967) **Wind characteristics for design of wind turbines: research in the USA.** Connell, J.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1 Dec 1979. Contract EY-76-C-06-1830. 22p. (CONF-7909128—1). Dep. NTIS, PC A02/MF A01.

From IEA expert meeting; Stockholm, Sweden (12 Sep 1979).

The Pacific Northwest Laboratory (PNL) of the United States Department of Energy has the primary responsibility for providing information on wind characteristics for design and for evaluation of performance of wind energy conversion systems (WECS). The objectives of the whole program are, broadly, to develop technical wind information which is relevant to the design of WECS, to determine suitable methods of measuring and analyzing the wind for evaluating WECS performance, and to communicate the information usefully to WECS designers.

18807 (RLO—2439-78/3) **Energy statistics for large wind turbine arrays. Annual progress report, May 1, 1977-April 30, 1978.** Justus, C.G.; Mikhail, A.S. (Georgia Inst. of Tech., Atlanta (USA)). May 1978. Contract EY-76-S-06-2439. 127p. Dep. NTIS, PC A07/MF A01.

Wind energy statistics of large arrays of wind energy conversion systems (WECS) have been studied in four regions of the country: the New England and Central United States regions (Justus, 1976) and the Great Lakes and Pacific Coast regions (Justus and Hargraves, 1977a). Results obtained from multiregional arrays of selected sites from these four previously studied regions are presented. The purpose of these multiregional analyses has been to investigate the upper limits of wind diversity benefit by studying large spatial areas to aid in determining if power might be produced by WECS in areas of high wind potential and transmitted over long distances to areas of high demand, and to use data from all four of the individual regions in developing and refining a generic methodology with which array statistical properties may be simulated adequately with simple averages or single-site input information.

ECONOMICS

REFER ALSO TO CITATION(S) 18805

18808 (ATR—78(7598)-2) **Electric utility application of wind energy conversion systems on the island of Oahu.** Lindley, C.A.; Melton, W.C. (Aerospace Corp., El Segundo, CA (USA). Energy and Resources Div.). 23 Feb 1979. Contract EX-76-C-01-2439. 348p. NTIS $18.00.

This wind energy application study was performed by The Aerospace Corporation for the Wind Systems Branch of the Depart-

ment of Energy. The objective was to identify integration problems for a Wind Energy Conversion System (WECS) placed into an existing conventional utility system. The integration problems included environmental, institutional and technical aspects as well as economic matters, but the emphasis was on the economics of wind energy. The Hawaiian Electric Company utility system on the island of Oahu was selected for the study because of the very real potential for wind energy on that island, and because of the simplicity afforded in analyzing that isolated utility.

WIND ENERGY ENGINEERING

APPLICATIONS

18809 (DOE/SEA—3707-20741/80/1) **Application of wind energy to Great Plains irrigation pumping. Final report.** Hagen, L.J.; Lyles, L.; Skidmore, E.L. (Kansas State Univ., Manhattan (USA). Agricultural Experiment Station). Oct 1979. Contract EX-76-A-29-1026. 160p. Dep. NTIS, PC A08/MF A01.

Wind energy systems without energy storage for irrigation in the Great Plains are studied. Major uses of irrigation energy were identified as pumping for surface distribution systems, which could be supplied by variable flow, and pumping for sprinkler systems using constant flow. A computer program was developed to simulate operation of wind-powered irrigation wells. Pumping by wind turbine systems was simulated for 2 variable and 2 constant flow operational modes in which auxiliary motors were used in 3 of the modes. Using the simulation program, the well yields and maximum pumping rates among the 4 modes as a function of drawdown in a typical well are compared.

TURBINE DESIGN AND OPERATION

18810 (CONF-781235—P1, pp 191-192) **Sow wind turbines and reap the wind.** Smith, O.J.M. (Univ. of California, Berkeley). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18811 (COO—4131-T1(Vol.2)) **Wind energy conversion. Volume II. Aerodynamics of horizontal axis wind turbines.** Miller, R.H.; Dugundji, J.; Martinez-Sanchez, M.; Gohard, J.; Chung, S.; Humes, T. (Massachusetts Inst. of Tech., Cambridge (USA). Aeroelastic and Structures Research Lab.). Sep 1978. Contract EY-76-S-02-4131. 213p. Dep. NTIS, PC A10/MF A01.

The basic aerodynamic theory of the wind turbine is presented, starting with the simple momentum theory based on uniform inflow and an infinite number of blades. The basic vortex theory is then developed. Following these basics, the more complete momentum theory, including swirl, non-uniform inflow, the effect of a finite number of blades, and empirical correction for the vortex ring condition is presented. The more complete vortex theory is presented which includes unsteady aerodynamic effects but based on a semi-rigid wake. Methods of applying this theory for performance estimation are discussed as well as for the purpose of computing time varying airloads due to windshear and tower interference.

18812 (COO—4131-T1(Vol.3)) **Dynamics of horizontal axis wind turbines. Wind energy conversion. ASRL-TR-184-9.** Miller, R.; Dugundji, J.; Chopra, I.; Sheu, D.; Wendell, J. (Massachusetts Inst. of Tech., Cambridge (USA). Aeroelastic and Structures Research Lab.). Sep 1978. Contract EY-76-S-02-4131. 149p. Dep. NTIS, PC A07/MF A01.

The underlying theory is presented for determining blade and rotor/tower vibration and dynamic stability characteristics. The dynamic analysis of horizontal axis turbines may be divided into two convenient areas, namely, (a) the investigation of the aeroelastic and response of a single blade on a rigid tower, and (b) the investigation of the mechanical stability and vibrations of the rotor system on a flexible tower. With a reasonable understanding of the behavior in these two areas, the completely coupled blade-tower aeroelastic system can be better understood, and dynamic problems can be better assessed.

18813 (COO—4131-T1(Vol.5)) **Wind energy conversion. Volume V. Experimental investigation of a horizontal axis wind turbine.** Dugundji, J.; Larrabee, E.E.; Bauer, P.H. (Massachusetts Inst. of Tech., Cambridge (USA). Aeroelastic and Structures Research Lab.). Sep 1978. Contract EY-76-S-02-4131. 66p. Dep. NTIS, PC A04/MF A01.

The results are presented of some brief experiments conducted on a wind turbine model of a rotor system to verify the aerodynamic theories developed and to investigate the dynamic excitation characteristics of wind turbines.

18814 (COO—4131-T1(Vol.6)) **Wind energy conversion. Volume VI. Nonlinear response of wind turbine rotor.** Chopra, I. (Massachusetts Inst. of Tech., Cambridge (USA). Aeroelastic and Structures Research Lab.). Sep 1978. Contract EY-76-S-02-4131. 231p. Dep. NTIS, PC A11/MF A01.

The nonlinear equations of motor for a rigid rotor restrained by three flexible springs representing, respectively, the flapping, lagging, and feathering motions are derived using Lagrange's equations, for arbitrary angular rotations. These are reduced to a consistent set of nonlinear equations using nonlinear terms up to third order. The complete analysis is divided into three parts, A, B, and C. Part A consists of forced response of two-degree flapping-lagging rotor under the excitation of pure gravitational field (i.e., no aerodynamic forces). In Part B, the effect of aerodynamic forces on the dynamic response of two-degree flapping-lagging rotor is investigated. In Part C, the effect of third degree of motion, feathering, is considered.

18815 (COO—4131-T1(Vol.7)) **Wind energy conversion. Volume VII. Effects of tower motion on the dynamic response of windmill rotor.** Sheu, D.L. (Massachusetts Inst. of Tech., Cambridge (USA). Aeroelastic and Structures Research Lab.). Sep 1978. Contract EY-76-S-02-4131. 61p. Dep. NTIS, PC A04/MF A01.

The effects of tower motion on the dynamic response of a windmill rotor are studied. The blade lagging and side tower motion are taken into consideration in the analysis. The equations of motion for the system are a set of linear ordinary differential equations having periodic coefficients. The periodic coefficients of the equations of motion for a three bladed rotor are eliminated by using the multiblade coordinate transformation method. For a two bladed rotor, the equations of motion are solved by using the harmonic balance method. In addition to both methods, the Floquet Transition Matrix method is shown to be an effective way in dealing with the linear ordinary differential equations having periodic coefficients. The differences between the instability regions for a three bladed system and for a two bladed system are discussed.

18816 (COO—4131-T1(Vol.9)) **Wind energy conversion. Volume IX. Aerodynamics of wind turbine with tower disturbances.** Chung, S.Y. (Massachusetts Inst. of Tech., Cambridge (USA). Aeroelastic and Structures Research Lab.). Sep 1978. Contract EY-76-S-02-4131. 103p. Dep. NTIS, PC A06/MF A01.

Lifting line theory which is the counterpart of Prandtl's lifting line theory for rotating wing is employed for the overall performance analysis of a horizontal axis wind turbine rotor operating in a uniform flow. The wake system is modeled by non-rigid wake which includes the radial expansion and the axial retardation of trailing vortices. For the non-uniform flow which are caused by the ground, the tower reflection, or the tower shadow, the unsteady airloads acting on the turbine blade are computed, using lifting line theory and a non-rigid wake model. An equation which gives the wind profile in the tower shadow region is developed. Also, the equations to determine pitch angle control are derived to minimize the flapping moment variations or the thrust variations due to the non-uniform flow over a rotation.

18817 (COO—4131-T1(Vol.10)) **Wind energy conversion. Volume X. Aeroelastic stability of wind turbine rotor blades.** Wendell, J. (Massachusetts Inst. of Tech., Cambridge (USA). Aeroelastic and Structures Research Lab.). Sep 1978. Contract EY-76-S-02-4131. 94p. Dep. NTIS, PC A05/MF A01.

The nonlinear equations of motion of a general wind turbine rotor blade are derived from first principles. The twisted, tapered blade may be preconed out of the plane of rotation, and its root may be offset from the axis of rotation by a small amount. The aerodynamic center, center of mass, shear center, and area centroid are distinct in this derivation. The equations are applicable to studies of forced response or of aeroelastic flutter, however, neither gravity forcing, nor wind shear and gust forcing are included. The equations derived are applied to study the aeroelastic stability of the NASA-ERDA 100 kW wind turbine, and solved using the Galerkin method. The numerical results are used in conjunction with a mathematical comparison to prove the validity of an equivalent hinge model developed by the Wind Energy Conversion Project at the Massachusetts Institute of Technology.

18818 (SAND—79-1753) **Aerodynamic performance of the 17-m-diameter Darrieus wind turbine in the three-bladed configuration: an addendum.** Worstell, M.H. (Sandia Labs., Albuquerque, NM (USA)). Feb 1980. Contract EY-76-C-04-0789. 59p. Dep. NTIS, PC A04/MF A01.

The US Department of Energy (DOE)/Sandia 17-m wind turbine has been tested in the three-bladed configuration at five rotational speeds. These data are presented along with some fundamental comparisons to the earlier two-bladed results. Also included is the theoretical output of the three-bladed 17-m wind turbine at two selected rotational speeds.

POWER CONVERSION SYSTEMS

18819 (COO—4131-T1(Vol.4)) **Wind energy conversion. Volume IV. Drive system dynamics.** Martinez-Sanchez, M.; Labuszewski, T.

(Massachusetts Inst. of Tech., Cambridge (USA). Aeroelastic and Structures Research Lab.). Sep 1978. Contract EY-76-S-02-4131. 197p. Dep. NTIS, PC A09/MF A01.

The dynamics of the drive system and various approaches to power transmission are described. The effects on performance of using a constant rotor speed as opposed to a rotor speed varying with the wind speed are discussed for various rotor operating schedules and typical wind distributions. The dynamics of the combined rotor, alternator, and drive system are analyzed. Conditions which could lead to electro-dynamic instabilities and desynchronization are discussed as well as means for stabilizing the system. The dynamics of the drive system and important design conditions for various drive systems are discussed, such as location of the alternators, use of hydraulic drive systems and smoothing techniques.

18820 (DOE/R5/10129—1) **Energy from wind powered oscillators. Semi-annual technical progress report, August 1, 1979-January 31, 1980.** Starr, P.J. (Minnesota Univ., Minneapolis (USA). Dept. of Mechanical Engineering). 1980. Contract FG02-79R510129. 10p. Dep. NTIS, PC A02/MF A01.

Information is presented concerning a literature review on flow induced vibrations; an estimation of available power; design procedure for both votex shedding and galloping; and conversion schemes.

SITE CHARACTERISTICS

REFER ALSO TO CITATION(S) 18806

ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 18794

POWER PLANTS AND POWER GENERATION

REFER ALSO TO CITATION(S) 18308, 18627, 18797, 19033

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

18821 (DOE/TIC—3360(Suppl.4)) **Cooling towers: a bibliography, January-December 1979.** Raleigh, H.D. (comp.). (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Feb 1980. 118p. Dep. NTIS, PC A06/MF A01.

Included are 426 citations to references on cooling towers for fossil-fuel or nuclear power plants. A few citations are included on other types of condenser cooling systems, e.g., cooling ponds and canals. The citations were taken from the DOE Energy Information Data Base (EDB) covering the period January 1979 through December 1979. Corporate, Personal Author, Subject, and Report Number Indexes are provided.

18822 (PB—80-102767) **Assessment of three technologies for the treatment of cooling tower blowdown. Final report, September 1978-July 1979.** Houle, E.H.; Rogers, A.N.; Weekes, M.C.; May, S.C.; Mast, V.C.d. (Bechtel National, Inc., San Francisco, CA (USA)). Sep 1979. Contract EPA-68-02-2616. 89p. NTIS, PC A05/MF A01.

The report gives results of analyses of three methods for treating cooling tower blowdown: vapor compression evaporation (VCE), reverse osmosis (RO), and vertical tube foaming evaporation (VTFE). The two evaporative processes produce pure water (approximately 10 ppM dissolved solids). RO produces water of lower purity (about 500 ppm) but adequate for many uses in the power plant or for return to the cooling tower. VCE has been used successfully in commercial power plants; the evaporative processes have no plants in operation on cooling tower blowdown. Plant investment is strongly influenced by the cost of lined ponds required to evaporate the treatment plant blowdown and store the residual salts. Consequently, the RO plant investment is almost in the range of that of VTFE and VCE plants. In total capital plus operating costs, VTFE has a distinct advantage over RO and VCE because its source of energy is waste heat to which a zero value has been assigned. The VTFE economics is based on vertical tube evaporator experience (without adding surfactant). If field pilot tests substantiate previous laboratory results, the economics of the VTFE may prove to be even more favorable.

18823 (PNL—3149) **Potential use of dry cooling in support of advanced energy generation systems.** Mayer, D.W.; Arnold, E.M.; Allemann, R.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1979. Contract EY-76-C-06-1830. 110p. Dep. NTIS, PC A06/MF A01.

Advanced energy technologies were investigated for filling the energy supply and demand gap, including fuel cells, thermionic converters, and fusion. Technologies that have the potential for supplying energy in the future are solar, geothermal, coal gasification and liquefaction, clean solid fuel from coal, and oil shale. Results are presented of an analysis of the advanced energy generation systems, the potential for using dry cooling, and the waste heat generation characteristics of the advanced technologies. The magnitude of the waste heat expected to be generated indicates the following percentages of total cooling requirements would be needed by advanced energy technologies: (a) 1% to 2% in 1985, (b) 17% to 40% in 2000, and (c) 24% to 76% in 2025. Dry cooling could be required for flashed steam and dry steam geothermal plants if balancing withdrawal and reinjection of the geothermal fluid becomes a requirement. Binary cycle geothermal plants and plants using the hot dry rocks geothermmal resource are even more likely to require dry cooling since these plants will need an outside source of water. Solar central tower plants have a high potential for the use of dry cooling since they are likely to be located in the Southwest where water availability problems are already apparent. The high water consumption associated with the projected synthetic fuel production levels indicates that dry cooling will be desirable, perhaps even mandatory, to achieve a high level of synthetic fuel production. In the year 2000, between 2.5 and 13 GW of electrical energy produced by advanced power generation systems may require dry cooling. In the year 2025, this requirement may increase to between 4.5 and 81 GW/sub e/.

POWER CYCLES

REFER ALSO TO CITATION(S) 18634, 18832, 18971

18824 (FE—1806-76) **Development of high-temperature turbine subsystem technology to a technology readiness status phase II. Quarterly report, October-December 1979.** (General Electric Co., Schenectady, NY (USA). Gas Turbine Div.). 1979. Contract EX-76-C-01-1806. 129p. Dep. NTIS, PC A07/MF A01.

The objective of the DOE-HTTT (High-Temperature Turbine Technology) program is to bring to technology readiness, over a six- to ten-year duration, a high-temperature gas turbine for use in a combined-cycle power plant, with coal-derived fuel, at a firing temperature of 2600°F and with growth capability to 3000°F. This program has been divided into three phases: Phase I - Program and System Definition; Phase II - Technology Testing and Test Support Studies; and Phase III - Technology Readiness Verification Test Program. Phase I was completed, and Phase II commenced on August 1, 1977. The objectives of Phase II are to: (1) perform component design and technology testing in critical areas; (2) perform system design and trade-off analyses in sufficient depth to support the component design and test tasks; and (3) update the Phase I combined-cycle plant studies to evaluate the commercial viability of GE-TRV gas turbine system. Progress in these activities is reported.

18825 **Pressurized fluidized bed combined cycle power gneration.** Brooks, R.D.; Roberts, R. (General Electric Co., Schenectady, NY). pp 615-633 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

The Pressurized Fluidized Bed Combustor, when operated in conjunction with a steam and gas turbine combined-cycle power plant, offers several advantags for baseload electric utility power generation. The fluidized bed, with limestone or dolomite addition, permits direct combustion of high-sulfur coal without need for flue gas desulfurization to meet a 90% reduction of SO_2 level. The NO/sub x/ emissions from a Pressurized Fluidized Bed, in addition, are substantially below the levels encountered in conventional coal-fired furnaces and atmospheric fluid bed combustion. The Coal-Fired Combined Cycle (CFCC) is the particular version of the Pressurized Fluidized Bed Steam and Gas Turbine Power Plant Cycle currently under development by the General Electric Company. The CFCC development program, currently being supported by the Department of Energy, includes technology work in the combustor steam generator, gas turbine materials, and hot-gas cleanup areas, as well as commercial power plant definition and evaluation. The plant design and evaluation work has proceeded to the completion of a first design phase which includes definition of a reference configuration, and conduct of trade-offs in numerous areas in order to select the optimum design configuration and operating conditions. Experimental work has been conducted on combustor characteristics particulate removal, and gas turbine corrosion and erosion in several test rigs. Special design and materials approaches have been defined to provide acceptable life for the gas turbine. The low turbine operating temperatures (1400 to 1770°F inlet) permit use of current utility proven machines adapted to the external combustor configuration required by the Pressurized Fluidized Bed Combustor. This paper emphasizes key power plant technical areas and summarizes the recent experimental results in the supporting technical areas.

COMPONENTS

18826 (PNL—3289) **Improvement of sputtered oxide coating adherence and integrity for turbine airfoil applications. Combustion zone durability program. Task III: dense surface sputtered ceramic coatings. Annual technical progress report, October 1, 1978-September 30, 1979.** Patten, J.W.; Busch, R.; Moss, R.W.; Bayne, M.A.; Fairbanks, J.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1980. Contract EY-76-C-06-1830. 32p. Dep. NTIS, PC A03/MF A01.

Two aspects of the durability of modified ZrO_2 ceramic thermal barrier coatings for gas turbine airfoils are being investigated in this program. First, adherence of coatings of these materials has historically been difficult to achieve due to mismatch in thermal expansion coefficients and other properties between ceramic coatings and metallic substrates. Second, if the ceramic coatings are discontinuous, as for many plasma sprayed coatings, then condensate from the combustion environment may permeate the coating and volume changes in this condensate during subsequent service cycles may produce coating spallation. The adherence problem was approached by seeking to sputter deposit ceramic coatings over either sputter-etched, closely spaced, high aspect ratio substrate surface cones or by sputter depositing ceramic coatings over sputtered CoCrAlY coatings containing a very high density of columnar voids (leaders). The objective in both instances was to provide a compliant fibrous metal attachment between metal substrate and ceramic coating to absorb property mismatches. The permeability problem was approached both by coating a segmented (fibrous columnar) ceramic layer with a continuous and impervious metal sealing layer that is not required to provide structural strength or insulation, and by coating the segmented ceramic layer with a continuous layer of the same ceramic material.

ECONOMICS

REFER ALSO TO CITATION(S) 18828

OFF-PEAK ENERGY STORAGE

18827 (COO—2950-1) **Assessment of the zinc-bromine battery for utility load leveling. Final report.** Will, F.G.; Iacovangelo, C.D.; Jackowski, J.S.; Secor, F.W. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). 15 Mar 1978. Contract EY-76-C-02-2950. 255p. Dep. NTIS, PC A12/MF A01.

The technical and economic prospects of zinc-bromine batteries employing Nafion/sup R*/ fluorinated ion exchange membranes was evaluated. The applicability and performance limits of a variety of materials and concepts were explored, noval all-carbon electrode structures developed and tested in cells of up to 36 w-hr size, and a system design and cost analysis was performed.

FUELS

REFER ALSO TO CITATION(S) 18327

18828 **Advanced programs for utilization of coal for electric power generation.** McGowin, C.R. (Electric Power Research Inst., Palo Alto, CA); Yeager, K.E. pp 461-483 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

Expansion of coal-fired electric generation capacity is being affected in the US by escalating fuel and plant capital costs, increasingly strict environmental control requirements for heat rejection, air, water, and solid waste emissions, limited land and water availabilities, and delays in the permit application process. EPRI forecasts that the coal-fired power of the future will be designed for minimum heat rate and maximum reliability while meeting environmental control requirements. These plants will use supercritical steam cycles and integrated environmental controls that minimize heat rate penalty. Since environmental control regulations will significantly increase the cost of solid waste disposal, regenerable SO_2 scrubbers that produce gypsum or sulfur by-products will be preferred over sludge producing lime/limestone scrubbers. Other environmental controls will include fabric filter particulate controls, low NO/sub x/ burners and postcombustion NO/sub x/ controls, wet and wet/dry plant cooling systems, and zero discharge plant water systems. Over the longer term, atmospheric and pressurized fluidized bed combustion and gasification-combined cycle systems may provide lower cost and more efficient means of generating electricity from coal. However, further development of these technologies is necessary before they will be available for commercial application in the late 1980s and 1990s. In the meantime, new coal-fired power generation capacity will be provided by conventional coal-fired technology.

18829 **Use of coal for electric power generation to the end of the century.** Ross, B.A. (American Electric Power Service Corp., New York, NY). pp 745-762 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

Projections of US electric utilities use of coal require the examination of three sequentially related and one unrealted factor namely: national energy use; electric energy's share of national energy use; national generating capacity; and coal fueled generation's share of national generating capacity. This paper presents recently published forecasts of national energy use, national electric energy use, and national generating capacity composition in 1987 to 1990 and 1997 to 2000. Ranges and distribution of forecast values are examined and the factors affecting coal generation's share of total generating capacity are considered. Finally, generating capacity and coal use projections, which appear probable in view of the data available, are developed. Uncertainties with respect to: long term national energy growth; energy conservation developments; new energy sources and uses; gross national product growth; the future prospects for nuclear power; and future emission and mining regulation constraints on the use of coal may cause significant - at this time impossible to prognosticate - changes in long term utility coal use. Utility coal requirements anticipated for 1990 are between 900 million tons an 1100 million tons, and year 2000 requirements are forecast to be between 1400 million tons and 1900 million tons.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 18828

18830 (EPRI-FP—1205) **Evaluation of flood levels for solid waste disposal areas. Final report.** Grimsrud, G.P.; Franz, D.D.; Kliewer, D.D. (Hydrocomp, Inc., Mountain View, CA (USA)). Oct 1979. 189p. Dep. NTIS, PC A09/MF A01.

This report presents a survey of the potential impacts to the electric utility industry of EPA regulations which restrict the disposal of solid wastes in floodplains. It includes a survey of the locations of present and future coal-fired plants with respect to riverine and coastal floodplains. The survey shows that a majority of the coal-fired plants are located in or near a restricted floodplain. The report includes a computer listing of the plant-by-plant survey results. This report also presents a review and assessment of the Federal Insurance Administration (FIA) methods of flood mapping, which are to be used to enforce the EPA solid waste regulations. Major issues and concerns regarding the use of FIA maps/methods for enforcement of solid waste regulations are pointed out. Finally, preliminary guidelines are given for electric utility managers on how to estimate flood levels and/or respond to the flood levels already determined under the FIA program, and how to respond to the EPA flood level regulations.

18831 (NUREG/CR—1060) **Activities, effects, and impacts of the coal fuel cycle for a 1000-MWe electric power generating plant. Final report.** Christman, R.C.; Haslbeck, J.; Sedlik, B.; Murray, W.; Wilson, W. (Teknekron, Inc., Berkeley, CA (USA)). Feb 1980. 613p. NTIS.

Teknekron Research, Inc., under contract to the Nuclear Regulatory Commission, reviewed current literature pertaining to the health, ecological, economic, and social impacts of the coal fuel cycle. The computerized literature search revealed over 3000 relevant citations. A review of their abstracts resulted in the selection of over 200 particularly germane documents, which were eventually used in the preparation of this report. This data base was supplemented, as needed, by publications of the most recent research results from a number of Federal agencies. The result is the summation of the adverse societal impacts of all segments of the coal fuel cycle associated with a 1000-MWe power plant. The impacts and effects of the coal fuel cycle are presented in tabular form and normalized to a 1000-MWe power plant to facilitate comparison with the Table S-3 contained in 10 CFR Part 51.20(e), which summarizes the effects and impacts of the uranium fuel cycle for a 1000-MW(e) nuclear power plant. This report does not describe in detail the effects and impacts that result from long-term operation of many power plants nationwide or in a particular region of the country. These include the greenhouse effect, acid rain, chronic health impacts of trace metals and carcinogens, and long-range transport of sulfates. The report does, however, discuss the impacts of local air pollution, mining and transportation accidents, land disturbances, water pollution, and solid waste disposal. Socioeconomic impacts are also discussed in detail.

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 18307

18832 (ANL/CEN/FE—79-17) **Screening of granular sorbents for the removal of gaseous alkali metal compounds from hot flue gas.** Lee, S.H.D.; Swift, W.M.; Johnson, I. (Argonne National Lab., IL (USA)). Nov 1979. Contract W-31-109-ENG-38. 27p. Dep. NTIS, PC A03/MF A01.

Six commercially available sorbent materials have been tested as granular sorbents to be used in granular-bed filters for the removal of gaseous alkali metal compounds from the hot (800 to 880°C) flue gas of pressurized fluidized-bed combustors (PFBC) for proposed combined-cycle power generation. Tests were performed by passing simulated relatively dry flue gas of PFBC through granular-bed filters in either a laboratory-scale, fixed-bed combustor or a high temperature sorption test rig. The experimental results of screening tests are presented. Diatomaceous earth and activated bauxite were found to be the two most promising sorbents. Possible sorption mechanisms and applications of the sorbents are discussed. 3 figures, 7 tables.

18833 (EPA—600/7-79-199b) **Survey of flue gas desulfurization systems: Lawrence Energy Center, Kansas Power and Light Company.** Laseke, B.A. Jr. (PEDCO-Environmental, Inc., Cincinnati, OH (USA)). Aug 1979. 111p. NTIS.

The results of a survey of operational flue gas desulfurization (FGD) systems on coal-fired utility boilers in the United States are discussed. The FGD systems installed on Units 4 and 5 at the Lawrence Energy Center of the Kansas Power and Light Company is described in terms of design and performance. The FGD system installed on each unit consists of two parallel two-stage scrubber modules, each of which includes a rectangular, variable-throat rod-deck venturi scrubber arranged in series with a spray tower absorber. Each system is also equipped with slurry-hold tanks, mist eliminators, and in-line reheaters, as well as isolation and bypass dampers. The two systems share a common limestone storage and preparation facility and waste-disposal facility. These FGD systems represent a second generation design replacement of limestone furnace-injection and tail-end scrubbing systems which were originally installed on Units 4 and 5 in 1968 and 1971, respectively. The original systems operated approximately 27,000 h and 23,000 h on coal-fired flue gas for Units 4 and 5, respectively. The redesigned FGD system on Unit 4 went into service in early January 1977. The Unit 5 FGD system went into service on April 14, 1978.

18834 EPA—600/7-79-221a) **Executive summary for full-scale dual-alkali demonstration system at Louisville Gas and Electric Company. Final design and system cost.** VanNess, R.P.; Somers, R.C.; Weeks, R.C.; Frank, T.; Ramans, G.J.; LaMantia, C.R.; Lunt, R.R.; Valencia, J.A. (Louisville Gas and Electric Co., KY (USA)). Sep 1979. 33p. NTIS.

Phase 2 of a 4-phase demonstration program involving the dual alkali process for controlling SO_2 emissions from Unit 6, a coal-fired boiler at Louisville Gas and Electric Co.'s Cane Run Station is described. The process was developed by Combustion Equipment Associates, Inc., and Arthur D. Little, Inc. The program consists of four phases: (1) preliminary design and cost estimation; (2) engineering design, construction, and mechanical testing; (3) startup and performance testing; and (4) 1-year operation and test programs. Final engineering design, construction and mechanical testing, and installed system capital cost are discussed. Construction of the system was completed in February 1979 and system startup was initiated in March 1979. Total capital investment for the entire plant, including waste disposal, is estimated to be $20.4 million (construction of the waste disposal facilities is not complete).

18835 (PB—80-100654) **Design of photochemical reaction chamber.** Stockburger, L.; Meagher, J.F. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Office of Natural Resources). Jul 1979. 39p. NTIS, PC A03/MF A01.

A 1100-cu. ft. Teflon photochemical reaction chamber has been constructed by the Tennessee Valley Authority (TVA) to study chemical reactions that occur in dilute coal-fired power plant plumes. The chamber will be used to study, under controlled conditions, the gaseous and gas particulate reactions using actual flue gas under solar or simulated solar conditions. The chamber and associated instruments are transportable to allow evaluation of secondary pollutant formation from existing and new energy control technologies.

18836 (PB—80-102601) **Fabric filter system study: first annual report. Annual report, October 1977-October 1978.** Ladd, K.L.; Faulkner, G.R.; Kunka, S.L. (Southwestern Public Service Co., Amarillo, TX (USA)). Aug 1979. Contract EPA-68-02-2659. 81p. NTIS, PC A05/MF A01.

The report describes first-year activities of a comprehensive EPA-funded study of a commercial fabric filter unit on a 350-MW low-sulfur-coal-fired unit at Southwestern Public Service Company's Harrington Station at Amarillo, Texas. Two years will be required to complete collection and assessment of 1 full operating year's worth of data. Following the testing phase of the program, operational and maintenance data will continue to be recorded until 1982 to determine the long-term reliability of the system. Special tests will be conducted through the use of an onsite pilot baghouse. First-year activities include installation of support systems, startup of the full-scale fabric filter system, and planning for special test programs. Special testing on the full-scale system began in February 1979. Results will be included in the next annual report.

18837 **EPA program to develop advanced conventional coal combustion methods.** Martin, G.B.; Lachapelle, D.G. (Environmental Protection Agency, Research Triangle Park, NC). pp 485-512 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

The projected increased use of coal for industrial and utility steam generation will result in a significant increase in pollutant emissions unless more effective control technology is developed and implemented. There are three general approaches to use of coal in conventional combustion equipment: (1) direct combustion as a solid; (2) conversion to synthetic liquids; and (3) conversion to low or medium Btu gas. The ultimate choice of the technology for a given application will depend on a number of factors including: (1) pollutant emission control; (2) technical feasibility; (3) economics; and (4) energy efficiency. Additional information is required on all of these factors before the optimum approach can be selected. The primary concern in the EPA technology development program is emission control, although factors 2 to 4 are also being strongly considered. The purpose of this paper is to describe one aspect of that program, that is, the development of advanced conventional combustion systems for control of NO/sub x/ and other pollutants. The results of the program for coal and coal-derived fuels are described. Several coal- and shale-derived liquid fuels have been tested in a small-scale facility and show a correlation of fuel NO/sub x/ to fuel nitrogen content that is similar to conventional oils under fuel-lean conditions. Staged combustion and distributed mixing burner evaluations, which are in progress, are briefly described. A bench-scale evaluation of the effects of fuel composition and combustor design on emissions from low Btu gas combustion is described. NH_3 and hydrocarbon content of the fuel is shown to have the most significant effect on NO/sub x/ emissions, and the reactor design strongly influenced emissions from a given fuel.

18838 **Status of utility flue gas desulfurization in the United States.** Laseke, B.A.; Devitt, T.W. (PEDCo Environmental, Inc., Cincinnati, OH). pp 519-555 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

Pedco Environmental, Inc., under contract to the Industrial Environmental Research Laboratory-RTP and the Division of Stationary Source Enforcement of the US Environmental Protection Agency, has been monitoring the status of flue gas desulfurization (FGD) systems since 1974. Information is obtained by visits to plants having operational FGD systems and through periodic contacts with representatives of utility companies, FGD system suppliers, design engineering firms, and regulatory agencies. This paper, which summarizes the results of the program, includes the following: (1) the current status of FGD applications in the utility sector. The number and capacity of operational systems are identified by process type, as are those under construction and planned; (2) areas of technological advancement, including process and design changes in the first, second, and third generation FGD systems; (3) reported and adjusted capital and annual costs for operational FGD systems; and (4) recommendations for several research, development, and demonstration efforts that could be pursued to increase the efficiency and cost-effectiveness of FGD operation.

POWER TRANSMISSION AND DISTRIBUTION

18839 (CONF-800301—1) **Partial discharge inception and breakdown studies on model sheet-wound, compressed SF_6 gas-impregnated, polymer film-insulated windings.** Reed, C.W.; Philp, S.F.; Kawai, M.; Schneider, H.M. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.; General Electric Co., Pittsfield, MA (USA)). 1980. Contract EC-77-C-01-2134. 11p. Dep. NTIS, PC A02/MF A01.

From 2. international symposium on gaseous dielectrics; Knoxville, TN, USA (9 Mar 1980).

An investigation was made of advanced concepts for gas-insulated power transformers and experimental studies have been made on model turn-to-turn insulation structures comprised of sheet aluminum conductors insulated with two sheets of polymer film impregnated with compressed SF_6 gas. Precautions were taken to eliminate particles using electrostatic techniques during winding of the models. Partial discharge inception and breakdown measurements were made at 60 Hz applied voltages and room temperature; the effect of polymer film thickness was also investigated.

18840 (EPRI-EL—1266) **Laser detection of voids and contaminants in polyethylene-insulated power cables. Final report.** Cheo, P.K. (United Technologies Research Center, East Hartford, CT (USA)). Dec 1979. 74p. Dep. NTIS, PC A04/MF A01.

The results of a continuing effort leading toward the development of an on-line inspection instrument for quality control of extruded solid dielectric cable insulation are delineated. The inspection method involves the processing of far-infrared laser signals scattered from defects imbedded in cable insulation and has been well established during the Phase I program period. During the course of the Phase II program, a breadboard model of the cable inspection instrument utilizing the above method has been designed and fabricated. This laboratory breadboard was used successfully to demonstrate the real-time inspection of power distribution cables moving at normal extrusion speeds and to characterize insulation defects such as voids, contaminants, protrusions, skips and microporosity. In this demonstration, only one laser beam was used so that the region shadowed by the central conductor was not covered. Full coverage can be obtained with the use of multiple beams. Basically the breadboard consisted of an optically pumped laser source at the 119 μm wavelength, an optical scanner, an index matching device, a Cassegrain type optical collector, a multi-channel liquid-helium-cooled detection system and a computerized data processor. The studies of instrument data indicated that minimum detectable void size in 25 kV cable insulation is about 100 μm (4 mils). This result is consistent with the calculated result based on a Mie-scattering model.The minimum detectable size of contaminants is comparable to that of voids. The present breadboard system sensitivity is limited by the self-generated detector noise and the available laser power. Based on these limitations a lower limit to the detectable scattering background from microvoids was determined. This limit is equivalent to a microvoid diameter of 3μm at a density of 10^9 cm^{-3}.

18841 **Transmission Line Reference Book: wind-induced conductor motion.** Palo Alto, CA; Electric Power Research Inst. (1979). 254p. (NP—24368). EPRI, Palo Alto, CA.

A state-of-the-art study of conductor fatigue, aeolian vibration, conductor gallop, and wake-induced oscillation is presented. Each of these types of conductor behavior is explored in depth. Each chapter presents a detailed examination of the causes, mechanisms, incidence, types of motion, factors influencing motion, resulting damage, and protection methods associated with its particular topic. One or more detailed theoretical analyses are presented for each type of conductor behavior. Whenever possible, supporting (or conflicting) data from laboratory tests and field tests are presented. The strengths and limitations of the theories and of the various types of testing methods are examined. Each chapter includes extensive references to the work of other researchers.

AC SYSTEMS, EHV AND UHV

18842 (DOE/TIC—11120) **Evaluation, design, development, and delivery of a 1200 kV prototype termination. Fourth technical progress report, September 1-November 30, 1979.** Billings, J.S.; Cromer, C.F.; Fischer, W.H.; Meyer, J.R.; Bennett, A.I. Jr. (Westinghouse Electric Corp., Trafford, PA (USA). Power Circuit Breaker Div.). Feb 1980. Contract ET-78-C-01-3107. 47p. Dep. NTIS, PC A03/MF A01.

Detailed analytic and model studies of various 1200-kV termination concepts underway during the present period are described. Reduced scale models have been constructed for the electrical and mechanical studies. Test results are reported for the resistive grading study and the reinforcing liner study. Continuing analysis of the thermal characteristics of the various concepts is reported. The use of a heat pipe to remove localized heat from the SF_6-film condenser is recommended. Calculations of some of the mechanical clamping and fastening characteristics of the concepts are tabulated. Optional materials, configurations, and fabrication plans are expected to be determined upon completion of these studies.

DC SYSTEMS

18843 (DOE/TIC—11083) **Development of dc interrupters for the BEST Facility.** (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Sep 1978. Contract EX-76-C-01-2117. 169p. Dep. NTIS, PC A08/MF A01.

Technology for providing rapid and repeated interruptions of dc fault current in high power dc-ac conversion systems using line commutated current fed inverters is developed and verified. Requirements for coordinated back-up protection are analyzed. Particular emphasis is on implementing the technology on a scale sufficient to meet the needs of the National Battery Energy Storage Test (BEST) Facility and to gain an understanding of the capabilities and limitations of high speed fuses in the context of the application considered. The program achieved: (1) analysis and simulation of possible interrupter concepts; (2) small scale hardware modeling of an interrupter/inverter system complete with ac and dc interfaces; and (3) construction and test of a full scale interrupter. The model system consisted of two 6 pulse bridges with interrupters of the ringing bypass type, rated at 20 kW total with dc bus voltages of 500 maximum for series inverter operation and 250 maximum for parallel operation. The ac interface, with the inverters always operating at $\pi/6$ radians displacement to give 12 pulse system operation, was with a 440 V, 3-phase, 60 Hz supply appropriately scaled for source impedance.

18844 (EPRI-EL—1203) **Contamination effects on HVDC insulator flashover.** Cheng, T.C. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). Nov 1979. 189p. Dep. NTIS, PC A09/MF A01.

An integrated field and laboratory study was conducted to investigate the mechanism of flashover of contaminated insulators under high voltage dc conditions. Salient factors identified were reproduced under simulated conditions in the laboratory and the effects of each factor were studied. Newly discovered phenomena that occur during the flashover process, such as formation of clean cones and the deleterious effect of nitrates on glass-insulating materials, were observed. Theories were formulated to explain the mechanisms involved in these phenomena.

18845 (EPRI-EL—1260) **System studies for HVDC circuit breakers. Final report.** Bowles, J.P. (Institut de Recherche de l'Hydro-Quebec, Varennes (Canada)). Dec 1979. 361p. Dep. NTIS, PC A16/MF A01.

Although extensions to the basic philosophy are being considered all HVDC transmission systems to date have been built as point-to-point systems, usually operating in the bipolar mode to avoid continuous currents flowing in the earth. Five developments that promise to improve the flexibility, reliability, and operation of the system, make HVDC suitable for more applications and to reduce system costs, are considered and include: metallic return; parallel operation of lines and poles; parallel tapping of HVDC lines; HVDC ring systems; and diode rectifier systems. Studies on a powerful HVDC transmission simulator were carried out to determine the feasibility of such techniques. It was anticipated that the availability of HVDC circuit breakers would improve the performance of systems using these techniques and, therefore, the major objective of EPRI project RP:326-1 Systems Studies for HVDC Circuit Breakers was to determine the specification of HVDC circuit breakers for these particular applications. It was found in general that the performance of the system could be improved considerably by the availability of suitable HVDC breakers, but that the parameters of the breakers (e.g. configuration, speed, voltage rating, type of energy absorbing elements etc.) could influence the performance considerably.

NUCLEAR POWER PLANTS

18846 (ANL-CT—77-22(Rev.02)) **Level-one modules library for DSNP: Dynamic Simulator for Nuclear Power-plants.** Saphier, D. (Argonne National Lab., IL (USA)). Sep 1978. Contract W-31-109-ENG-38. 296p. Dep. NTIS, PC A13/MF A01.

The Dynamic Simulator for Nuclear Power-plants (DSNP) is a system of programs and data sets by which a nuclear power plant or part thereof can be simulated at different levels of sophistication. The acronym DSNP is used interchangeably for the DSNP language, for the DSNP precompiler, for the DSNP libraries, and for the DSNP document generator. The DSNP language is a set of simple block oriented statements, which together with the appropriate data, comprise a simulation of a nuclear power plant. The majority of the DSNP statements will result in the inclusion of a simulated physical module into the program. FORTRAN statements can be inserted with no restrictions among DSNP statements.

18847 (NP—24402) **History of nuclear power development in Connecticut. Background Paper No. 16.** Diehl, C. (Connecticut Office of Legislative Research, Hartford (USA)). Jan 1978. 16p. TIC.

The history of nuclear power in Connecticut is outlined. The context for the development of the present nuclear capacity is described.

18848 (UCRL—52732) **Dynamic testing of nuclear power plant structures: an evaluation.** Weaver, H.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1980. Contract W-7405-ENG-48. 50p. Dep. NTIS PC $8.50/MF $3.50.

Lawrence Livermore Laboratory (LLL) evaluated the applications of system identification techniques to the dynamic testing of nuclear power plant structures and subsystems. These experimental techniques involve exciting a structure and measuring, digitizing, and processing the time-history motions that result. The data can be compared to parameters calculated using finite element or other models of the test systems to validate the model and to verify the seismic analysis. This report summarizes work in three main areas: (1) analytical qualification of a set of computer programs developed at LLL to extract model parameters from the time histories; (2)

examination of the feasibility of safely exciting nuclear power plant structures and accurately recording the resulting time-history motions; (3) study of how the model parameters that are extracted from the data be used best to evaluate structural integrity and analyze nuclear power plants.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 18851, 18875, 18895

18849 **Operating US power reactors.** Cottrell, W.B. *Nucl. Saf.*; 21: No. 1, 116-123(Jan 1980).

The operation of US power reactors during September and October 1979 is summarized. Events of special note are discussed in the text, and the operational performance of all licensed power reactors is presented. These data are taken from the monthly Operating Units Status Report prepared by NRC.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 18875, 18877, 18889, 18891, 18892, 18895, 18896, 18897

18850 (CEND—377(Vol.2)) **Conceptual design of a large Spectral Shift Controlled Reactor.** Matzie, R.A.; Menzel, G.P. (Combustion Engineering, Inc., Windsor, CT (USA)). Aug 1979. Contract EN-77-C-01-5070. 648p. Dep. NTIS, PC A99/MF A01.

Within the framework of the Nonproliferation Alternative Systems Assessment Program (NASAP), the US Department of Energy (DOE) has sponsored the development of a conceptual design of a large Spectral Shift Controlled Reactor (SSCR). This report describes the results of the development program and assesses the performance of the conceptual SSCR on the basis of fuel resource utilization and total power costs. The point of departure of the design study was a 1270 MW(e) PWR using Combustion Engineering's System 80/sup TM/ reactor and Stone and Webster's Reference Plant Design. The initial phase of the study consisted of establishing an optimal core design for both the once-through uranium cycle and the denatured U-235/thorium cycle with uranium recycle. The performance of the SSCR was then also assessed for the denatured U-233/thorium cycle with uranium recycle and for the plutonium/thorium cycle with plutonium recycle. After the optimal core design was established, the design of the NSSS and balance of plant was developed.

18851 (NUREG/CR—0957) **FLX: a shell code for coupled fluid-structure analysis of core barrel dynamics.** Dienes, J.K.; Hirt, C.W.; Rivard, W.C.; Stein, L.R.; Torrey, M.D. (Los Alamos Scientific Lab., NM (USA)). Nov 1979. Contract W-7405-ENG-36. 53p. (LA—7927). Dep. NTIS, PC A04/MF A01.

The coupled fluid-structure dynamics of a light water reactor core support barrel can be calculated by the K-FIX(3D,FLX) and SOLA-FLX codes. The fluid dynamics is described by the three-dimensional, two-fluid code K-FIX(3D) or the two-dimensional, drift-flux code SOLA-DF. The structural dynamics is described by the three-dimensional, elastic shell code FLX. FLX, which uses an explicit finite-difference solution algorithm to solve the shell equations, is explicitly coupled to the fluid-dynamics codes. Motion may be induced by blowdown, prescribed displacement, or seismic action. A sample calculation is provided for verification.

18852 (NUREG/CR—1007) **Evaluation of selected signal processing methods for the characterization of steam generator eddy current signals.** Brown, S.D.; Hayford, D.T. (Brookhaven National Lab., Upton, NY (USA)). Aug 1979. Contract EY-76-C-02-0016. 89p. (BNL-NUREG—51044). Dep. NTIS, PC A05/MF A01.

The primary objective of this program was to implement a digital computer subtraction techique and evaluate the method using eddy current data derived from models of observed in-service defects. The Zetec ML-2 signal analyzer was also briefly examined. A secondary objective was to investigate the multifrequency aspects of eddy current inspection with regards to the detection and characterization of signal types. Digital subtraction techniques, in which a reference support plate signal is subtracted from a distorted support plate signal with the defect signal remaining as the resultant, have been examined by implementing computer programs on a PDP 11/40 and also using a commercially available signal analyzer. Multifrequency eddy currents, in which a coil is excited at more than one frequency, offers advantages in characterizing certain primary or secondary side tube conditions. The use of more than one inspection frequency can provide additional information in the characterization of laminated support plates, tube dings and magnetic tube deposits.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 18869, 18874, 19137

18853 (ORNL/TM—7035) **Performance of HTGR fertile particles irradiated in HFIR capsule HT-32.** Long, E.L. Jr.; Robbins, J.M.; Tiegs, T.N.; Kania, M.J. (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 76p. Dep. NTIS, PC A05/MF A01.

The HT-32 experiment was an uninstrumented capsule irradiated for four cycles in the target position of the High-Flux Isotope Reactor (HFIR). The experiment was designed to: provide supplemental simulated fuel rods for thermal transport and expansion measurements; test fertile kernels with Al_2O_3 and SiO_2 additives for improved fission product retention; study the stability and permeability of low-temperature isotropic (LTI) pyrocarbon coatings; test Biso- and Triso-coatings derived in a large (0.24-m-dia) coating furnace with a frit distributor; investigate the performance of particles with an outer layer of SiC both as loose particles and as resin-bonded fuel rods; and evaluate high-density alumina as a potential high-temperature thermometry sheathing material.

POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

18854 (CEND—379(Vol.2)) **Conceptual design of a large heavy water reactor for US siting.** Shapiro, N.L.; Jesick, J.F. (Combustion Engineering, Inc., Windsor, CT (USA)). Sep 1979. Contract EN-77-C-01-5068. 494p. Dep. NTIS, PC A21/MF A01.

Information is presented concerning optimization of the pressurized heavy water reactor design and conceptual design characteristics of a 1260 MW(e) pressurized heavy water reactor.

18855 (CEND—379(Vol.3)) **Conceptual design of a large heavy water reactor for US siting.** Shapiro, N.L.; Jesick, J.F. (Combustion Engineering, Inc., Windsor, CT (USA)). Sep 1979. Contract EN-77-C-01-5068. 365p. Dep. NTIS, PC A16/MF A01.

Information is presented concerning fuel management and safety and licensing assessment of the pressurized heavy water reactor; and commercial introduction of the pressurized heavy water reactor in the United States.

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 18888, 18893

18856 (EPRI-NP—1000(Vol.1)) **Optimization of radially heterogeneous 1000-MW(e) LMFBR core configurations. Design and performance of reference cores. Research project 620-25.** Barthold, W.P.; Orechwa, Y.; Su, S.F.; Hutter, E.; Batch, R.V.; Beitel, J.C.; Turski, R.B.; Lam, P.S.K. (Argonne National Lab., IL (USA)). Nov 1979. Contract W-31-109-ENG-38. 164p. Dep. NTIS, PC A08/MF A01.

A parameter study was conducted to determine the interrelated effects of: loosely of tightly coupled fuel regions separated by internal blanket assemblies, number of fuel regions, core height, number and arrangement of internal blanket subassemblies, number and size of fuel pins in a subassembly, etc. The effects of these parameters on sodium void reactivity, Doppler, incoherence, breeding gain, and thermohydraulics were of prime interest. Trends were established and ground work laid for optimization of a large, radially-heterogeneous, LMFBR core that will have low energetics in an HCDA and will have good thermal and breeding performance.

18857 (EPRI-NP—1000(Vol.2)) **Optimization of radially heterogeneous 1000-MW(e) LMFBR core configurations. Appendixes A and B. Research project 620-25.** Barthold, W.P.; Orechwa, Y.; Su, S.F.; Hutter, E.; Batch, R.V.; Beitel, J.C.; Turski, R.B.; Lam, P.S.K. (Argonne National Lab., IL (USA)). Nov 1979. Contract W-31-09-ENG-38. 82p. Dep. NTIS, PC A05/MF A01.

A parameter study was conducted to determine the interrelated effects of: loosely or tightly coupled fuel regions separated by internal blanket assemblies, number of fuel regions, core height, number and arrangement of internal blanket subassemblies, number and size of fuel pins in a subassembly, etc. The effects of these parameters on sodium void reactivity, Doppler, incoherence, breeding gain, and thermohydraulics were of prime interest. Trends were established and ground work laid for optimization of a large, radial-

ly-heterogeneous, LMFBR core that will have low energetics in an HCDA and will have good thermal and breeding performance.

18858 (EPRI-NP—1000(Vol.3)) **Optimization of radially heterogenous 1000-MW(e) LMFBR core configurations. Appendix C. Research project 620-25.** Barthold, W.P.; Orechwa, Y.; Su, S.F.; Hutter, E.; Batch, R.V.; Beitel, J.C.; Turski, R.B.; Lam, P.S.K. (Argonne National Lab., IL (USA)). Nov 1979. Contract W-31-109-ENG-38. 191p. Dep. NTIS, PC A09/MF A01.

A parameter study was conducted to determine the interrelated effects of: loosely or tightly coupled fuel regions separated by internal blanket assemblies, number of fuel regions, core height, number and arrangement of internal blanket subassemblies, number and size of fuel pins in a subassembly, etc. The effects of these parameters on sodium void reactivity, Doppler, incoherence, breeding gain, and thermohydraulics were of prime interest. Trends were established and ground work laid for optimization of a large, radially-heterogeneous, LMFBR core that will have low energetics in an HCDA and will have good thermal and breeding performance.

18859 (EPRI-NP—1000(Vol.4)) **Optimization of radially heterogeneous 1000-MW(e) LMFBR core configurations. Appendixes D and E. Research project 620-25.** Barthold, W.P.; Orechwa, Y.; Su, S.F.; Hutter, E.; Batch, R.V.; Beitel, J.C.; Turski, R.B.; Lam, P.S.K. (Argonne National Lab., IL (USA)). Nov 1979. Contract W-31-109-ENG-38. 83p. Dep. NTIS, PC A05/MF A01.

A parameter study was conducted to determine the interrelated effects of: loosely or tightly coupled fuel regions separated by internal blanket assemblies, number of fuel regions, core height, number and arrangement of internal blanket subassemblies, number and size of fuel pins in a subassembly, etc. the effects of these parameters on sodium void reactivity, Doppler, incoherence, breeding gain, and thermohydraulics were of prime interest. Trends were established and ground work laid for optimization of a large, radially-heterogeneous, LMFBR core that will have low energetics in an HCDA and will have good thermal and breeding performance.

18860 (GA-A—15628) **Gas-Cooled Fast Breeder Reactor. Quarterly progress report, August 1, 1979-October 31, 1979.** (General Atomic Co., San Diego, CA (USA)). Nov 1979. Contract AT03-76SF71023. 400p. Dep. NTIS, PC A17/MF A01.

Information is presented concerning the nuclear steam supply system; reactor core; project support; alternate fuel cycles; and circulator test facility.

18861 (HEDL-SA—2014) **Ultrasonic off-normal imaging techniques for under sodium viewing.** Michaels, T.E.; Horn, J.E. (Hanford Engineering Development Lab., Richland, WA (USA)). 6 Dec 1979. Contract EY-76-C-14-2170. 18p. (CONF-800231—1). Dep. NTIS, PC A02/MF A01.

From 3. international conference on nondestructive evaluation in the nuclear industry; Salt Lake City, UT, USA (11 Feb 1980).

Advanced imaging methods have been evaluated for the purpose of constructing images of objects from ultrasonic data. Feasibility of imaging surfaces which are off-normal to the sound beam has been established. Laboratory results are presented which show a complete image of a typical core component. Using the previous system developed for under sodium viewing (USV), only normal surfaces of this object could be imaged. Using advanced methods, surfaces up to 60 degrees off-normal have been imaged. Details of equipment and procedures used for this image construction are described. Additional work on high temperature transducers, electronics, and signal analysis is required in order to adapt the off-normal viewing process described here to an eventual USV application.

18862 (HEDL-SA—2027-A-FP) **Ultra high vacuum fracture and transfer device for AES analysis of irradiated austenitic stainless steel.** Urie, M.W.; Panayotou, N.F.; Robinson, J.E. (Hanford Engineering Development Lab., Richland, WA (USA)). 1980. Contract EY-76-C-14-2170. 33p. (CONF-800318—2). Dep. NTIS, PC A03/MF A01.

From Pittsburgh conference; Atlantic City, NJ, USA (9 Mar 1980).

An ultrahigh vacuum fracture and transfer device for analysis of irradiated and non-irradiated SS 316 fuel cladding is described. Mechanical property tests used to study the behavior of cladding during reactor transient over-power conditions are reported. The stress vs temperature curves show minimal differences between unirradiated cladding and unfueled cladding. The fueled cladding fails at a lower temperature. All fueled specimens failed in an intergranular mode. (FS)

18863 (LA—8229-MS) **Efficient beam-column finite element including application to thermoelastic deformation.** Ju, F.D. (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7405-ENG-36. 32p. Dep. NTIS, PC A03/MF A01.

During the study of the structural design of the core of the Gas Cooled Fast Reactor (GCFR), there is evidence of undue frictional interaction between fuel rod claddings and their spacer grids. In cases for which thermal bowing of the rods is sufficient to cause two-sided contact between the rods and their supporting grids (and thus a tendency to lock up), subsequent rod deformation caused by the axial thermal expansion would result in excessive buckling of the rods between locked supports. The numerical solution is best served by the finite element method. Yet there is a large number of fuel rods in the reactor, of which each is multiply-supported by spacers. Hence, an efficient finite element is needed that would model each section between supports with not more than three elements. The new efficient finite element is developed, beginning with the principle of virtual work.

18864 (LA—8238-PR) **Examination of fast reactor fuels and FBR analytical quality assurance standards and methods. Progress report, October 1-December 31, 1979.** Maraman, W.J. (comp.). (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7405-ENG-36. 12p. Dep. NTIS, PC A02/MF A01.

This project is directed toward the examination and comparison of the effects of neutron irradiation of Liquid Metal Fast Breeder Reactor (LMFBR) Program fuel materials. Unirradiated and irradiated materials will be examined as requested by the Reference Fuels System Branch of the Division of Reactor Research and Technology (DRRT). Reliable chemical characterizations are essential to the development of high-quality fuels, control rods, and other reactor components in the FBR Program. The objective tasks are designed to assure the quality of the chemical characterizations necessary to evaluate reactor components relative to specifications.

18865 (PNL-SA—7878) **Analysis of steady state combined forced and free convection data in rod bundles.** Juneau, J.; Khan, E.U.; Cheatham, R.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1979. Contract EY-76-C-06-1830. 6p. (CONF-791103—75). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Fuel and blanket assemblies in an LMFBR are subjected to a wide range of power and power gradients during their life in the reactor. To accommodate these changes the assemblies operate in a wide range of flow regimes extending from forced convection, turbulent flow, to mixed convection, laminar flow. At low flow conditions the transverse temperature gradient in an assembly is considerably flattened because of energy redistribution by not only wire-wrap mixing and thermal conduction but also by flow redistribution because of buoyancy-induced crossflow. This has significance in LMFBR design. For the mixed convection regime of bundle operation, the transverse velocity profiles within a bundle change axially because of buoyancy-induced crossflow. It was therefore decided to use the ENERGY II and ENERGY III computer programs for the analysis of the rod bundle mixed convection data.

18866 (SAND—79-1693) **HTFLO: a computer model of a resistively-heated UO_2 pin with a rate-dependent heat capacity.** Smaardyk, J.E. (Sandia Labs., Albuquerque, NM (USA)). Feb 1980. Contract EY-76-C-04-0789. 40p. Dep. NTIS, PC A03/MF A01.

A one-dimensional model is presented to describe the thermal behavior of an uranium dioxide (UO_2) rod that is heated resistively and cooled by surface radiation. A standard forward differencing scheme is used for the heat transfer calculations. Temperature-dependent electrical and thermal properties are calculated at the beginning of each time step. In addition, the heat capacity is calculated from a dynamic enthalpy model based on equilibrium and instantaneous heat capacity models with a user-selectable relaxation time. This report describes the finite difference equations used, the treatment of the source and boundary terms, and the dynamic enthalpy model. Detailed input instructions are provided and a sample calculation is shown.

18867 (WAPD-TM—869) **Characteristics of the Zircaloy-4 tubing in LWBR fuel rods. (LWBR Development Program).** Eyler, J.H. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Nov 1979. Contract EY-76-C-11-0014. 131p. Dep. NTIS, PC A07/MF A01.

This report compares the required and actual chemical, physical, and metallographic properties of the tubing used in the manufacture of fuel rods for the Light Water Breeder Reactor (LWBR) at Shippingport, Pennsylvania. The processing of the low hafnium content Zircaloy-4 ingots into tube reduced seamless tubing is described, including some innovative practices used to meet certain requirements for LWBR which are not normally specified but have potential applicability to other reactors. Information is presented that relates the tube properties to the specific fabrication sequence and to the individual test technique used to generate the data.

18868 **Thermal analysis of an in-reactor LMFBR irradiation creep experiment.** Feldman, E.E. (Argonne National Lab., IL (USA)). *Nucl. Eng. Des.;* **53**: No. 1, 1-10(Jun 1979).

Thermal analyses of an in-reactor liquid metal fast breeder reactor (LMFBR) irradiation creep experiment and the test probe experiment which preceded it have been performed with the aid of a

finite-difference heat transfer computer code. The calculated axial temperature distribution for the probe experiment is compared with the measured distribution. Although there is a 15% overprediction, the relative axial temperature distributions agree rather well. The thermal response of both experiments to a loss-of-flow transient is also analyzed.

FUEL CYCLE

REFER ALSO TO CITATION(S) 18850

PROCESS HEAT REACTORS

REFER ALSO TO CITATION(S) 18323

18869 (Juel-Spez—48) **Calculations and analysis of steam methane reforming using high temperature reactor heat.** Neis, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Jul 1979. 155p. (In German). Dep. NTIS (US Sales Only), PC A08/MF A01.

The application of nuclear process heat for steam methane reforming as a modification of conventional technology is studied. For that purpose a computer program was developed which allows the calculation of heat transfer to an extend heated tubular reactor in which the catalytic reaction takes place. Calculations for comparison with experimental data are in satisfactory agreement. A sensitivity analysis shows the influence of single model parameters on the computational results. From parametric studies design data for steam reformers are obtained which may serve as basis for project work of a process heat plant.

NUCLEAR REACTOR TECHNOLOGY

THEORY AND CALCULATION

REFER ALSO TO CITATION(S) 18900, 18901

18870 (LA—8247-PR) **Transport and reactor theory. Progress report, October 1-December 31, 1979.** Dudziak, D.J.; O'Dell, R.D.; Alcouffe, R.E. (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7405-ENG-36. 49p. Dep. NTIS, PC A03/MF A01.

Research and development progress in transport and reactor theory by the Los Alamos Scientific Laboratory's Group T-1 for the first quarter of FY 80 is reported. Included are tasks in the areas of Fission Reactor Neutronics, Transport Methods Supporting Research, Reactor Safety Analysis, Fusion Reactor Nucleonics, Shielding Methods, and Safeguards Analysis.

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 19147, 19268

18871 (UCID—18144) **Analytical qualification of system identification (modal analysis) codes for use in the dynamic testing of nuclear power plant structures.** Weaver, H.J.; Ng, D.; Lager, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Jan 1980. Contract W-7405-ENG-48. 43p. Dep. NTIS, PC A03/MF A01.

The analytical evaluation of two particular system identification codes used at Lawrence Livermore Laboratory is presented. Both codes are eigenparameter identification codes; however, one uses a time domain approach while the other a frequency domain approach. The evaluation was accomplished by analytically generating several time history signals in which the true modal parameters were known. These time histories ranged from widely spaced modes with spacing factors of 100 percent to closely spaced modes with spacing factors of 6 percent. These signals were then polluted with various levels of simulated measurement noise and the ability of our computer codes to extract the parameters from this noisy data was evaluated.

FUEL ELEMENTS

18872 (HEDL-SA—1745-FP) **Automated in-line measurement of nuclear fuel pellets.** McLemore, D.R.; Nyman, D.H. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1979. Contract EY-76-C-14-2170. 9p. (CONF-791180—1). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society conference; Charleston, SC, USA (25 Nov 1979/REPLACED BY CONF-791117).

The Hanford Engineering Development Laboratory (HEDL) operated by the Westinghouse Hanford Company for the United States Department of Energy is currently developing, fabricating, and evaluating automated fuel fabrication equipment. This program has as its major goals: reduced personnel exposure, improved safeguards/accountability and improved fuel performance. One of the automated equipment items which has been fabricated is a fuel pellet inspection system. This system inspects fuel pellets for surface flaws and measures pellets for length, diameter, and weight at a rate of one pellet per second. The inspected pellets are sorted automatically and the results of the inspection are transmitted to a central computer for trend analysis and verification of accountability data.

18873 (UCRL-Trans—11557) **Production of microspheres of nuclear fuels and others by gelation of droplets.** Egli, W.; Bailey, W.H. Jr.; Leary, D.F.; Lansley, R.J. Dec 1979. Translation of . French Patent Application 76 00917. 15p. Dep. NTIS, PC A02/MF A01.

This invention relates generally to a process and a device for producing microspheres. More particularly, the invention relates to a process and a device particularly useful for the production of grains of nuclear fuel by the sol-gel process.

CONTROL SYSTEMS

18874 (GA-A—15677) **Dynamics and control modeling of the closed-cycle gas turbine (GT-HTGR) power plant.** Bardia, A. (General Atomic Co., San Diego, CA (USA)). Feb 1980. Contract AT03-76SF70046. 32p. (CONF-800332—1). Dep. NTIS, PC A03/MF A01.

From 4. power plant dynamics, control and testing symposium; Gatlinburg, TN, USA (17 Mar 1980).

The simulation if presented for the 800-MW(e) two-loop GT-HTGR plant design with the REALY2 transient analysis computer code, and the modeling of control strategies called for by the inherently unique operational requirements of a multiple loop GT-HTGR is described. Plant control of the GT-HTGR is constrained by the nature of its power conversion loops (PCLs) in which the core cooling flow and the turbine flow are directly related and thus changes in flow affect core cooling as well as turbine power. Additionally, the high thermal inertia of the reactor core precludes rapid changes in the temperature of the turbine inlet flow.

18875 (GEFR-SP—203) **Defect flow analysis of control rod drive operational events.** Thaggert, H.L.; Jacobs, I.M.; Crellin, G.L.; Smith, A.M. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Mar 1980. Contract AT03-76SF71032. 9p. (CONF-800403—12). Dep. NTIS, PC A02/MF A01.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

A Defect Flow Analysis of Control Rod (CR) and Control Rod Drive Mechanism (CRDM) Licensee Event Report Data is conducted to extract lessons learned information from past experience with light water nuclear reactors operating in the US. The analysis results are used to formulate characteristics of CR/CRDM defects. Among those formulated are (1) the leading direct cause of defects are inadequate design and inadequate training, (2) a relatively large number of defects are systematic, and (3) defects which result in system failure are rare. The analysis results indicate that most defects could have easily been prevented.

ENVIRONMENTAL ASPECTS

SITING

REFER ALSO TO CITATION(S) 19508

RADIOACTIVE EFFLUENTS

REFER ALSO TO CITATION(S) 19503

18876 (PB—296289) **Summary of radioactivity released in effluents from nuclear power plants from 1972 thru 1975.** Phillips, J.W.; Gruhlke, J.; Gaul, G.A. (Office of Radiation Programs, Washington, DC (USA). Technology Assessment Div.). May 1977. 122p. NTIS, PC A06/MF A01.

This is the first in a series of annual summaries of radioactive waste being released from, or shipped off-site by, nuclear power plants in the United States. The report provides a consolidated source of data. This report covers only those long lived isotopes which are generally released in sufficient quantities to be environmentally significant over extended periods of time in the biosphere. This report includes those plants which reached commercial operation, or had measurable releases prior to commercial operation, as of December 1975, and includes only those isotopes of environmen-

tal and radiological significance. All of the information in this report was taken from the individual plant semi-annual or annual operating reports filed by the responsible utility with the Nuclear Regulatory Commission unless otherwise noted.

CHEMICAL AND THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 19704

18877 (PB—80-105968) **Physical hydrography and dispersion in a segment of the Chesapeake Bay adjacent to the Calvert Cliffs Nuclear Power Plant. Special report (final).** Pritchard, D.W.; Rives, S.R. (Johns Hopkins Univ., Baltimore, MD (USA). Chesapeake Bay Inst.). Aug 1979. 382p. NTIS, PC A17/MF A01.

This report gives the results of an analysis of data collected during a field study conducted in a segment of the Chesapeake Bay adjacent to the Calvert Cliffs Nuclear Power Plant during October 1977. The field study was first conceived with the primary intent of obtaining data to be used for boundary values and for verification of a three-dimensional numerical model now under development for application to the study area. A second major purpose was then added, that of describing the horizontal and vertical distribution of dilution and of excess temperature in the near and intermediate field of the thermal plume that results from the discharge of heated effluent from the power plant. The final purpose of the study was to obtain data adequate for evaluation of the far field of dilution of the effluent plume.

18878 (UCID—17744-80-1) **Chemical effluents in surface waters from nuclear power plants. Quarterly progress report.** Harrison, F.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1980. Contract W-7405-ENG-48. 15p. Dep. NTIS, PC A02/MF A01.

A field survey was conducted at the H.B. Robinson Nuclear Power Station in November 1979 to measure copper concentrations and distributions in the surrounding waters. Copper concentrations were considerably higher in the intake and discharge waters than in control waters; the difference in total copper concentration between the intake and discharge waters was 17.3 μg Cu/l. Copper was present in labile forms in waters collected from the intake and discharge areas, but not in that from the control site. Results from ultrafiltration of the water indicate that organic matter does not play an important role in copper speciation at this site. Copper concentrations in bedload sediments collected from the discharge zone were higher than those from the intake and control areas; considerable heterogeneity in copper concentration at each site was detected. Copper distribution coefficients indicate that both discharge and control sediments had a high affinity for copper.

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 18894

18879 (HEDL-SA—1605-FP) **Closed Loop In-Reactor Assembly (CLIRA): a fast flux test facility test vehicle.** Oakley, D.J. (Hanford Engineering Development Lab., Richland, WA (USA)). 12 Sep 1978. Contract EY-76-C-14-2170. 28p. (CONF-781202—42). Dep. NTIS, PC A03/MF A01.

From ASME meeting; San Francisco, CA, USA (10 Dec 1978).

The Closed Loop In-Reactor Assembly (CLIRA) is a test vehicle for in-core material and fuel experiments in the Fast Flux Test Facility (FFTF). The FFTF is a fast flux nuclear test reactor operated for the Department of Energy (DOE) by Westinghouse Hanford Company in Richland, Washington. The CLIRA is a removable/replaceable part of the Closed Loop System (CLS) which is a sodium coolant system providing flow and temperature control independent of the reactor coolant system. The primary purpose of the CLIRA is to provide a test vehicle which will permit testing of nuclear fuels and materials at conditions more severe than exist in the FTR cor·, and to isolate these materials from the reactor core.

18880 (HEDL-SA—1921-FP) **Post test evaluation of natural circulation in FFTF secondary loops.** Beaver, T.R.; Turner, D.M.; Additon, S.L. (Hanford Engineering Development Lab., Richland, WA (USA)). Feb 1980. Contract EY-76-C-14-2170. 19p. (CONF-800226—5). Dep. NTIS, PC A02/MF A01.

From Specialists meeting on decay heat removal and natural circulation in FBR's; Upton, NY, USA (28 Feb 1980).

Two transient tests in one of the FFTF secondary heat transport loops were performed (March to May 1979) in order to verify that the transition to natural convective flow could be effected from near isothermal refueling conditions without excessive cooling at the air dump heat exchangers. Following the tests, the best estimate computer model was calibrated against the data, yielding in the process insights about the loop parameters and the probable suitability of the model structure. Key empirical parameters of pressure drop and heat loss were found to be at 62% and 81% of the pretest safety evaluation model parameter values, respectively. Pretest piping thermal transport and flow calculational models required no further revision to produce good agreement with the test data. Additional detail in the air dump heat exchanger heat loss model, accounting for long structural thermal time constants, was found to be necessary to obtain model agreement with transient outlet temperature data. The pretest model had conservatively employed steady state heat losses for transient calculations.

18881 (HEDL-TME—79-72) **DILATE: a 2-d structural program for the dilation response of hexagonal ducts.** Chan, D.P. (Hanford Engineering Development Lab., Richland, WA (USA)). Feb 1980. Contract EY-76-C-14-2170. 48p. Dep. NTIS, PC A03/MF A01.

An analytical method is introduced for determining the dilation of hexagonal ducts in fast reactors. The method, which is valid for temperatures where creep is linearly dependent on stress, was implemented in a fast-running computer called DILATE. A benchmark program is presented, which shows the results of the DILATE program in close agreement with the results of the finite element program MARC-CDC. User instructions for the DILATE program are described in detail and a listing of the program is included.

18882 (IAEA—214) **Research reactor renewal and upgrading programs.** (International Atomic Energy Agency, Vienna (Austria)). Sep 1978. 365p. Dep. NTIS (US Sales Only), PC A16/MF A01.

Separate abstracts were prepared for each paper presented.

18883 (IAEA—214, pp 317-325) **Improving the proliferation resistance of research and test reactors.** Lewis, R.A. (Argonne National Lab., IL (USA)). Sep 1978.

In Research reactor renewal and upgrading programs.

Elimination, or substantial reduction, of the trade in unirradiated highly-enriched fuel elements for research and test reactors would significantly reduce the proliferation risk associated with the current potential for diversion of these materials. It is the long-term goal of U.S. policy to fuel all new and existing research and test reactors with uranium of less-than-20% enrichment excepting, perhaps, only a small number of high-power, high-performance, reactors. The U.S. development program for enrichment reduction in research and test reactor designs currently using 90-93% enriched uranium is based on the practical criterion that enrichment reduction should not cause significant flux performance or burnup performance degradation relative to the unmodified reactor design. This implies the requirement that the ^{235}U loading in the reduced-enrichment fuel elements be the same as the ^{235}U loading in the 90-93% enriched fuel elements. This can be accomplished by substitution of higher uranium density fuel technology for currently-used fuel technology in the fuel meat volume of the current fuel element design and/or by increasing the usable fuel meat volume. For research and test reactors of power greater than 5-10 megawatts, fuel technology does not currently exist that would permit enrichment reductions to below 20% utilizing this criterion. A program is now beginning in the U.S. to develop the necessary fuel technology. Currently-proven fuel technology is capable of accommodating enrichment reductions to the 30-45% range (from 90-93%) for many reactors in the 5-50MW range. Accordingly the U.S. is proposing to convert existing reactors (and new designs) in the 5-50MW range from the use of highly-enriched fuel to the use of 30-45% enriched fuel, and reactors of less that about 5MW to less-than-20% enrichment.

18884 (ORNL/TM—7222) **Oak Ridge Research Reactor quarterly report, July, August and September 1979.** Hurt, S.S. III; Lance, E.D. (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 31p. Dep. NTIS, PC A03/MF A01.

The ORR operated at an average power level of 29.6 MW for 90.1% of the time during July, August and September of 1979. The reactor was shut down on eight occasions, one of which was unscheduled. Reactor downtime needed for refueling, maintenance and checks was normal, with the reactor remaining available for operation 93.7% of the time. Maintenance activities, both mechanical and instrument, were essentially routine in nature with the exception of one Reactor Instrument and Controls Design Change Memo.

18885 (ORNL/TM—7236) **Bulk Shielding Facility quarterly report, July, August and September 1979.** Hurt, S.S.; Lance, E.D.; Thomas, J.R. (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 29p. Dep. NTIS, PC A03/MF A01.

The Bulk Shielding Reactor (BSR) operated at an average power level of 9965 kW for 71.28% of the time during July, August and September. Water-quality control in both the reactor primary and secondary cooling systems was satisfactory. The Pool Critical Assembly (PCA) was operated on forty-six occasions for the Pressure Vessel Simulator Benchmark experiment.

18886 (SAND—79-1480) **Sandia Pulsed Reactor Facility (SPRF) calculator-assisted pulse analysis and display system.** Estes, B.F.; Berry, D.T. (Sandia Labs., Albuquerque, NM (USA)). Feb 1980. Contract EY-76-C-04-0789. 32p. Dep. NTIS, PC A03/MF A01.

Two solid-metal fast burst type reactors (SPR II and SPR III) are operated at the Sandia Pulsed Reactor Facility. Since startup of the reactors, oscilloscope traces have been used to record (by camera) the pulse (power) shape while log N systems have measured initial reactor period. Virtually no other pulse information is available. A decision was made to build a system that could collect the basic input data available from the reactor - fission chambers, photodiodes, and thermocouples - condition the signals and output the various parameters such as power, energy, temperature, period and lifetime on hard copy that would provide a record for operations personnel as well as the experimenter. Because the reactors operate in short time frames - pulse operation - it is convenient to utilize the classical Nordheim-Fuchs approximation of the diffusion equation to describe reactor behavior. This report describes the work performed to date in developing the calculator system and analytical models for computing the desired parameters.

REACTOR SAFETY

REFER ALSO TO CITATION(S) 19729

18887 **Scram signal generator.** Johanson, E.W.; Simms, R. US Patent Application 039,426. [nd]. 14p.

A scram signal generating circuit for nuclear reactor installations monitors a flow signal representing the flow rate of the liquid sodium coolant which is circulated through the reactor, and initiates reactor shutdown for a rapid variation in the flow signal, indicative of fuel motion. The scram signal generating circuit includes a long-term drift compensation circuit which processes the flow signal and generates an output signal representing the flow rate of the coolant. The output signal remains substantially unchanged for small variations in the flow signal, attributable to long term drift in the flow rate, but a rapid change in the flow signal, indicative of a fast flow variation, causes a corresponding change in the output signal. A comparator circuit compares the output signal with a reference signal, representing a given percentage of the steady state flow rate of the coolant, and generates a scram signal to initiate reactor shutdown when the output signal equals the reference signal.

18888 (ANL—79-104) **Finite-element method for above-core structures.** Kennedy, J.M.; Belytschko, T.B. (Argonne National Lab., IL (USA)). Dec 1979. Contract W-31-109-ENG-38. 50p. Dep. NTIS, PC A03/MF A01.

Three-dimensional finite-element models for the treatment of the nonlinear, transient response of a fast breeder reactor's above-core structures are described. For purposes of treating arbitrarily large rotations, node orientations are described by unit vectors and the deformable elements are treated by a corotational formulation in which the coordinate system is embedded in the elements. Deformable elements may be connected either to nodes directly or through rigid bodies. The time integration is carried out by the Newmark β method. These features have been incorporated to form the finite-element program SAFE/RAS (Safety Analysis by Finite Elements/ Reactor Analysis and Safety Division). Computations are presented for semianalytical comparisons, simple scoping studies, and Stanford Research Institute (SRI) test comparisons.

18889 (CONF-800331—1) **Automated uncertainty analysis methods in the FRAP computer codes.** Peck, S.O. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 41p. Dep. NTIS, PC A03/MF A01.

From IAEA specialists meeting; Blackpool, UK (17 Mar 1980).

A user oriented, automated uncertainty analysis capability has been incorporated in the Fuel Rod Analysis Program (FRAP) computer codes. The FRAP codes have been developed for the analysis of Light Water Reactor fuel rod behavior during steady state (FRAPCON) and transient (FRAP-T) conditions as part of the United States Nuclear Regulatory Commission's Water Reactor Safety Research Program. The objective of uncertainty analysis of these codes is to obtain estimates of the uncertainty in computed outputs of the codes is to obtain estimates of the uncertainty in computed outputs of the codes as a function of known uncertainties in input variables. This paper presents the methods used to generate an uncertainty analysis of a large computer code, discusses the assumptions that are made, and shows techniques for testing them. An uncertainty analysis of FRAP-T calculated fuel rod behavior during a hypothetical loss-of-coolant transient is presented as an example and carried through the discussion to illustrate the various concepts.

18890 (EGG-EA—5112) **Estimators for the binomial failure rate common cause model.** Atwood, C.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1980. Contract EY-76-C-07-1570. 83p. Dep. NTIS, PC A05/MF A01.

In Vesely's binomial failure rate model, a system of m components is hit by random shocks which may cause components simultaneously to fail, each component equal probability. Individual components may also fail when no shock has occurred. The data possibilities considered are that caused of single failures are identifiable (as shock or not) or not identifiable. Given data from such a system, non-Bayesian and Bayesian point and interval estimators are found for the various quantities of interest. Residual analyses and hypothesis tests are presented for checking the model assumptions. An example is worked out.

18891 (EGG-TFBP—5107) **Program requirements to determine and relate fuel damage and failure thresholds to anticipated conditions in pressurized water reactors.** Loyd, R.F.; Croucher, D.W. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1980. Contract EY-76-C-07-1570. 121p. Dep. NTIS, PC A06/MF A01.

Anticipated transients, licensing criteria, and damage mechanisms for PWR fuel rods are reviewed. Potential mechanistic fuel rod damage limits for PWRs are discussed. An expermental program to be conducted out-of-pile and in the Engineering Test Reactor (ETR) to generate a safety data base to define mechanistic fuel damage and failure thresholds and to relate these thresholds to the thermal-hydraulic and power conditions in a PWR is proposed. The requirements for performing the tests are outlined. Analytical support requirements are defined.

18892 (EGG/YBR—45-80) **WRRD monthly report for February 1980.** (Idaho National Engineering Lab., Idaho Falls (USA)). Mar 1980. Contract EY-76-C-07-1570. 172p. Dep. NTIS, PC A08/MF A01.

Technical and budget information is presented concerning Semiscale; the thermal fuels behavior program; 3-D program; code development and analysis program; and code assessment and applications program.

18893 (HEDL-SA—1747-FD) **Fission gas behavior in mixed-oxide fuel during transient overpower.** Randklev, E.H.; Treibs, H.A.; Mastel, B.; Baldwin, D.L. (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract EY-76-C-14-2170. 13p. (CONF-790816—86). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

Fission gas behavior can be important in determining fuel pin and core performance during a reactor transient. The results are presented of examinations characterizing the changes in microstructural distribution and retention of fission gas in fuel for a series of transient overpower (50 cents/s) tested mixed-oxide fuel pins and their steady state siblings.

18894 (HEDL-SA—1920S) **Computer simulation of natural circulation in FFTF secondary loops.** Beaver, T.R.; Turner, D.M.; Additon, S.L. (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1979. Contract EY-76-C-14-2170. 10p. (CONF-800226—2). Dep. NTIS, PC A02/MF A01.

From Specialists meeting on decay heat removal and natural circulation in FBR's; Upton, NY, USA (28 Feb 1980).

A thermal/hydraulic model of the FFTF secondary heat transport loop has been calibrated against transient natural circulation test data collected March to May 1979. The tests verified that the transition to natural convective flow could be effected from near isothermal conditions without excessive cooling at the air dump heat exchangers. Key empirical parameters of pressure drop and heat loss were found to be at 88% and 81% of pretest estimates, respectively. Pretest piping thermal transport and flow calculational models required no further revision to produce good agreement with test data.

18895 (LA—8256-MS) **Light-water reactor accident classification.** Washburn, B.W. (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7405-ENG-48. 37p. Dep. NTIS, PC A03/MF A01.

The evolution of existing classifications and definitions of light-water reactor accidents is considered. Licensing practice and licensing trends are examined with respect to terms of art such as Class 8 and Class 9 accidents. Interim definitions, consistent with current licensing practice and the regulations, are proposed for these terms of art.

18896 (NUREG/CR—1111) **Development of a fabrication procedure for the MRBT fuel simulator based on the use of cold-pressed boron nitride preforms.** McCulloch, R.W.; Jacobs, P.T.; Clark, D.L. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 162p. (ORNL/NUREG/TM—362). Dep. NTIS, PC A08/MF A01.

The Multirod Burst Test (MRBT) Program requires prompt availability of high-quality fuel simulators (FSs) to meet its program objectives (studies of Zircaloy deformation resulting from postulated PWR LOCA conditions). The FS electrically simulates the thermal

behavior of the nuclear fuel. The primary FS performance requirement is uniform axial clad temperature distribution (maximum allowable deviation of +- 1.5%) during transient conditions. This is determined by transient infrared examination of the FS ramped to 500°C (932°F) at a rate of 50°C (90°F) per second. (The industrially procured simulators rarely met this requirement, yet many were used for less critical applications.) This report delineates the development of a new fabrication technology for the FS by the ORNL Fuel Rod Simulator Technology Development Program; this technology alleviated the difficulties encountered with simulators procured from industrial sources.

18897 (PB—296197) **Population dose and health impact of the accident at the Three Mile Island Nuclear Station. Final report, 28 March-7 April 1978.** (Ad Hoc Population Dose Assessment Group, Washington, DC (USA)). 10 May 1979. 106p. NTIS, PC A06/MF A01.

The report was prepared by technical staff members of the Nuclear Regulatory Commission (NRC), the Department of Health, Education, and Welfare (HEW), and the Environmental Protection Agency (EPA), who consitute an Ad Hoc Population Dose Assessment Group. It is an assessment of the health impact on the approximately 2 million offsite residents within 50 miles of the Three Mile Island Nuclear Station from the dose received by the entire population (collective dose). The Ad Hoc Group has examined in detail the available data for the period up to and including April 7, 1979. Based on a preliminary review of data from periods beyond April 7, it appears that the collective dose will not be significantly increased by extending the period past April 7.

18898 Initiation of melt fragmentation in fuel-coolant interactions. Drumheller, D.S. (Sandia Labs., Albuquerque, NM). *Nucl. Sci. Eng.;* **72**: No. 3, 347-356(Dec 1979).

In many cases, the mixing of drops of hot liquid fuel with a more volatile coolant results in stable film boiling about the drops. At some later time, a disturbance can fragment the drops. This fragmentation increases the contact area between the liquids and results in a violent vaporization of the coolant. An understanding of this fragmentation mechanism is crucial to the prediction of the likelihood of violent fuel-coolant interactions. A fragmentation mechanism is proposed. It is shown how moderate pressure disturbances can cause the symmetrical collapse of a vapor film and allow the coolant to impact the drop. The impact is shown to be of sufficient strength to fragment the drop. This model quantitatively predicts the conditions necessary to lead to extensive fragmentation.

18899 Concentric-sphere design for spacing of tag-gas isotopic ratios. Gross, K.C. (Argonne National Lab., IL). *Nucl. Technol.;* **45**: No. 2, 195-197(Sep 1979).

An analytical tag-design scheme is presented that can be used to compute the isotopic compositions for a system of tag nodes, used to identify failed fuel assemblies in reactors with gas-bonded nuclear fuels. The tag nodes are located uniformly across the surfaces of two concentric spheres. This design minimizes the possibility of ambiguous leaker identification in the event of double-assembly failures, while reducing the enrichment requirements for the noble gases used to create the tags. Reducing the enrichment requirements lowers the overall tag costs and makes the design particularly well suited for reactors requiring large numbers of distinct tags.

18900 Dispersed flow film boiling during reflooding. Peake, W.T. Berkeley, CA; Univ. of California (1979). 217p. University Microfilms Order No. 80-00,477.

Thesis (Ph. D.).

A droplet model was used for the analysis of the fluid flow and heat transfer in the dispersed flow film boiling regime during reflooding of a tubular channel. Comparisons have been made of the predicted wall heat fluxes, vapor temperatures, qualities, and droplet diameters and the experimental data. The method of analysis applied was used in steady state post dryout heat transfer studies. It consists of modelling the flow as droplets scattered in a vapor environment. The drop size is assumed to be uniform at each axial location but is allowed to vary downstream. Empirical correlations are used to predict the drop heat transfer and fluid flow. Both forced convection heat transfer from the vapor to the droplets and radiation heat transfer from the wall to the droplets are included. The radiation heat transfer has been calculated using the mean beam length approximation and scattering has been neglected. Wall-droplet convective heat transfer has been ignored. A set of four ordinary differential equations govern the fluid conditions. The dependent variables are: droplet diameter, droplet velocity, quality, and vapor temperature. These four equations are solved simultaneously and integrated downstream from specified initial conditions.

18901 Study of heat transfer in the nucleate, transition, and inverted annular film boiling regions during reflooding. Abdollahian, D. Berkeley, CA; Univ. of California (1979). 164p. University Microfilms Order No. 80-00,263.

Thesis (Ph. D.).

A heat transfer model has been used to predict the wall temperatures in the nucleate boiling, transition boiling and the inverted annular film boiling regions during reflooding of a single tube. The predicted temperatures were compared with the experimental data that were obtained at atmospheric pressure. The inverted annular region existed in all the reflooding runs as long as the liquid temperature at the quench front remained below the saturation temperature. The flow regime above the quench front then changed to annular flow, that is, a thin film of liquid separated the wall from the vapor core.

ENERGY STORAGE

REFER ALSO TO CITATION(S) 18794, 19128

18902 (DOE/CS—0150) **Thermal and mechanical energy-storage program: project summary data, FY 1980.** (Department of Energy, Washington, DC (USA). Div. of Energy Storage Systems). Mar 1980. 196p. Dep. NTIS, PC A09/MF A01.

The Department of Energy's Division of Energy Storage Systems (STOR) is supporting a broad range of projects to conserve energy and to make possible shifting away from oil and natural gas by developing new and/or improved energy-storage systems applicable to central power generation, dispersed power generation, solar and waste heat utilization, and vehicle propulsion. These programs include: Thermal Energy Storage; Chemical/Hydrogen Energy Storage; Mechanical and Magnetic Energy Storage; and Underground Energy Storage. Technical and Economic Analysis is supported concurrently to evaluate competitive energy storage options. This summary report addresses the above categories except for Technical and Economic Analysis. Thermal and Chemical/Hydrdogen Energy Storage technologies offer the greatest potential for near-term impact of all the storage technologies under development. During FY 80, STOR will commit nearly $32 million to the Thermal and Mechanical Energy Storage Program. The breakdown of budget authorized funding for FY 1979 and Fy 1980 is shown. This publication consists principally of summary sheets for each active project in the Thermal, Chemical/Hydrogen, and Mechanical Energy Storage Program for FY 1979. Each summary includes: project title, principal investigator, organization, project goals, project status, contract number, contract period, funding level and funding source. An overview section is given before each set of project summaries.

FLYWHEELS

REFER ALSO TO CITATION(S) 19096

THERMAL

REFER ALSO TO CITATION(S) 18632, 18778, 18780, 19093, 19096

18903 (CONF-781235—P1, pp 13-14) **Overview of the DOE thermal storage program.** Swet, C.J.; Gahimer, J. (Dept. of Energy, Washington, DC). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18904 (CONF-781235—P1, pp 107) **Combined latent and sensible heat systems.** Smith, O.J.M. (Univ. of California, Berkeley). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18905 (SAND—80-8205) **Sigma phase formation in alloys for SO_2/SO_3 thermal energy storage systems.** Hughes, D.A. (Sandia Labs., Livermore, CA (USA)). Feb 1980. Contract EY-76-C-04-0789. 39p. Dep. NTIS, PC A03/MF A01.

A screening test was completed which identifies the tendency for sigma phase formation in alloys for SO_2/SO_3 thermal energy storage systems. The candidate alloys include austenitic and ferritic stainless steels, Fe-Ni Base, and Ni base alloys. Test specimens were aged for 4,000 hours at ambient temperature, 700, 800, 900, and 1000°C. Aged specimens were tested for Charpy V-notch toughness. Decreases in toughness upon aging correlated well with the observed changes in microstructure.

CHEMICAL

REFER ALSO TO CITATION(S) 18491, 18494, 18666, 18668, 18670

18906 (EUR—6646(Pt.2)) **Investigation of heat storages with salt hydrate as storage medium based on the extra water principle.** Furbo, S. (Danmarks Tekniske Hoejskole, Lyngby. Thermal Insulation Lab.). 1980. 83p. Dep. NTIS (US Sales Only), PC A05/MF A01.

Experimental and computational studies of a full scale heat storage with salt hydrate as storage medium and based on the extra water principle are reported. Two different types of full-scale heat storage, both making use of an incongruently melting salt hydrate as storage medium and based on the extra water principle, were examined by means of long-term experiments. In the first heat storage type, oil as heat transfer fluid in direct contact with the storage medium was used. The second storage type was a mantle storage where water as heat transfer fluid was circulated in the mantle. No decrease in the performance of the storages during the long term experiments was observed, and experiences for both storage types are obtained. By means of computer calculations, heat of fusion storage with oil as the heat transfer fluid in direct contact with the storage medium were compared with hot water storage as part of solar heating systems with the Danish Reference Year as a basis. With results of these calculations, examples of economical comparisons between heat of fusion storage and hot water storages are carried out. Considerations and experiments concerning storage material, stability of heat storage, and heat transfer capacity are carried out.

BATTERIES

REFER ALSO TO CITATION(S) 18827, 19096

DESIGN AND DEVELOPMENT

18907 (AD-A—068422) **Lithium-thionyl chloride battery. Quarterly report no. 1, 1 October-31 December 1978.** Dey, A.N.; Bowden, W.; Miller, J.; Witalis, P. (Mallory (P.R.) and Co., Inc., Burlington, MA (USA). Lab. for Physical Science). Apr 1979. Contract DAAB07-78-C-0563. 70p. NTIS, PC A04/MF A01.

The $Li/SOCl^2$ inorganic electrolyte system is the highest energy density system known to date. It consists of a Li anode, a carbon cathode and $SOCl^2$, which acts both as a solvent and as a cathode active material. The electrolyte salt that has been used most extensively is $LiAlCl^4$, but salts such as $Li^2B^{10}Cl^{10}$ and $Li^2(OAlC^3)^2$ have also been used successfully in this system for improving the shelf-life characteristics. The main objective of this program is to develop high-rate $Li/SOCl^2$ cells and batteries for various portable applications of the U. S. Army. The cells and batteries must deliver higher energy densities than are presently available and must be safe to handle under U. S. Army field conditions.

PERFORMANCE AND TESTING

18908 (AD-A—074001/9) **Methodology investigation exposure/performance tests of selected materiel items. Final report, July 1973-April 1975.** Downs, G.F.; Gorak, R.J. (Army Tropic Test Center, New York 09827 (USA)). Jan 1979. 73p. NTIS PC A04/MF A01.

USATTC conducted a methodology investigation in the Canal Zone from July 1973 to April 1975 to study the relationships among performance of materiel, exposure, and materials deterioration. Representative items of Army materiel were selected, exposed in different modes in the humid tropics, and performance tested at regular intervals. Objectives were to learn how and when to measure performance, to relate the performance measures to materiel deterioration, and to learn how and when to apply nondestructive test (NDT) techniques. The pallet and tarpaulin-forest storage mode provided the most severe environment. Use of this storage mode in tropic surveillance tests will uncover materiel design weaknesses more rapidly than other common long-term storage modes. In general, exterior visible evidence of material degradation should not be used for item performance predictions. Test items exposed in the humid tropics should be performance tested and fully disassembled and examined to determine the full extent of tropic deterioration. Further studies are required to investigate techniques for quantifying the severity of microbial attack and distinguishing between destructive and nondestructive growth. Meaningful application of NDT techniques to test items during tropic surveillance testing requires further refinement. An investigation should be undertaken to examine state-of-the-art NDT techniques for application to tropic testing. (Author)

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 18972, 19128, 19154

ENERGY MANAGEMENT AND POLICY

18909 (DOE/EIA—0205/1) **Energy information referral directory.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jan 1980. 34p. Dep. NTIS, PC A03/MF A01.

The National Energy Information Center (NEIC) provides energy information and referral assistance to federal, state, and local governments, the academic community, business and industrial organizations, and the general public. The two principal functions related to this task are: (1) operating a general-access telephone line, and (2) responding to energy-related correspondence addressed to the Energy Information Administration (EIA). To assist the NEIC staff in directing inquiries to the proper office within the Department of Energy (DOE) or other federal agencies, the Energy Information Referral Directory was developed. The arrangement of the Directory is topical. The office of primary interest for a particular activity in DOE or other agencies is listed. Specific subtopics (e.g., building and community systems, appropriate technology) within each broad category are indicated by a bullet symbol. In addition, each subtopic is assigned an alpha-numeric designation for use in the accession of entries from the index. Most entries provide an abbreviated office address. For the complete address, consult the Building Location Index. Following the name and title is the DOE routing symbol which refers to the organization and is part of the mailing address. To request information from EIA, contact first the National Energy Information Center: by mail, 1726 M St., NW 20461; by phone, Statistical Info., (202)-634-5610; EIA Publications, (202)-634-5694.

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 18932, 18935, 18936, 18960, 18962, 18967

18910 (DOE/EIA—451887) **Research into the methodology of the LEAP model.** Falk, J.E.; McCormick, G.P.; Soland, R.M. (George Washington Univ., Washington, DC (USA). School of Engineering and Applied Science). Dec 1979. Contract EM-78-S-01-5256. 130p. Dep. NTIS, PC A07/MF A01.

This report summarizes the research carried out in the analysis of the LEAP model and its underlying methodology. The report is divided into two parts, with the first part describing the LEAP model (as opposed to the algorithm used to solve the model), and placing it in context with the general economic theory. A basic result of the first part emphasizes that LEAP is mathematically a simulation model described by sets of equations governing the relations between quantities and prices of various commodities at various processes over time. It is not an optimization model, but can be conceptualized as an n-person sequential game. The equations that constitute LEAP are structured in such a way that their solution (if one exists) can be conveniently handled with the Successive Over-Relaxation Method. The second part of this report treats various aspects and extensions of this method, as well as alternate methods commonly employed to solve simultaneous equations. Remarks addressing decomposition are also developed in this part.

18911 (DOE/TIC—11131) **Energy basis for the United States.** Odum, H.T.; Alexander, J.F.; Wang, F.; Brown, M.; Burnett, M.; Costanza, R.; Kangas, P.; Swaney, D.; Leibowitz, S.; Lemlich, S. (Florida Univ., Gainesville (USA). Dept. of Environmental Engineering). Jun 1979. Contract EY-76-S-05-4398. 447p. Dep. NTIS, PC A20/MF A01.

In this annual report, energy-systems language was used to overview the energy basis of the US showing the vitality of the economy dependent on matching of high-quality fuel energies with lower-quality renewable energies based on the sun. When expressed in calories of the same type of energy, the US economy is 1/3 from the renewable energies and 2/3 from fuels, although most evaluations of national energy omit the environmental energies because the indirect contribution to the economy through life-support services is not recognized. Overview simulation models show a cresting to US growth as net energies of resident fuels decrease and as net energy in exchange of foreign trade also decreases. As fuels become less yielding, the environmental portion of the nation's energy becomes proportionately more valuable. Means were pursued for quantitative evaluation of the environmental energies in order to predict their role, evaluate which are most important, evaluate environmental impact questions, and provide guidelines for new public policy for the coming period of regression. The various kinds of environmental energies constitute a hierarchy from dilute solar energy to more concentrated winds, water flows, and tides. Determining their equivalence to fuels for operating the economy required estimation of energy-quality-transformation efficiencies. These quality factors are for flows and storages of environmental energy.Storages of environmental energy embodied in soils, forests, and geological forms of

landscapes were calculated. A separate abstract was prepared for each of the 13 individual reports.

18912 (DOE/TIC—11131, pp 8-82) **Energy embodied in the global energy WEB.** Alexander, J.F. Jr. Jun 1979.

In Energy basis for the United States.

The biosphere has evolved a global energy web converting sunlight, tide, and residual earth heat into a web of energies of varying quality and concentration. This study of this phenomenon develops a world model and assembles data on the world energy web from which embodied energy can be calculated to help evaluations of contribution to economies of humans and of nature. The global model connects energy concentration, storage, and consumer subsystems into a web, which provides a framework and also helps to explain the nature and function of disasters in a global context. The model also outlines a conceptual network for evaluating the flows and storages of energy that power various global processes. The web is composed of self-regulating units that successfully converge energy of the sun. Each module produces order and releases it with a pulsed consumption that forms a temporary high-energy system. According to theory, this pattern of energy, in order to survive in competition, must couple with or feed back pulses of energy to other systems. Pulsing the energy that is fed back in a control action produces an amplifier effect in disordering and recycling other systems. It is reasoned that systems that survive are those able to become organized and adapted to operate in a regime of pulses and use these pulses to power recycling processes and other means to achieve maximum power. 55 references, 12 figures, 7 tables.

18913 (DOE/TIC—11131, pp 83-109) **Energy criteria for water use.** Wang, F.C.; Odum, H.T.; Costanza, R. Jun 1979.

In Energy basis for the United States.

The theory that water resources can be evaluated by their embodied energy is implemented with examples. The energy embodied in fresh water is estimated as the energy of one type and quality required directly and indirectly to produce it in processes of the biosphere or of man's activities. The energy effect of water is calculated as the energy flow of one type it produces in a specific use. Energy analysis is applied as an inclusive overview method for managing land and water resources. The analysis employs the conceptual tools of energy quality, embodied energy, and energy-amplifier effect. A simple land-use model representative of the major land-use systems is formulated. The theory of selection for maximum power is applied and coupled with linear-programming techniques to suggest an optimal method for determining the best use of water for the combined economics of humanity and nature. The objective function is structured in terms of the total energy productivity of all the subsystems. The maximum-power principle is employed as a more-inclusive criterion than the usual profit or utility maximization. In the example applied to Lee County, Florida, the results are within the range of the county's current land distribution. Energy criteria permit decisions on water in terms readily comparable with other energy supply and storage questions. 24 references, 10 figures, 3 tables.

18914 (DOE/TIC—11131, pp 110-122) **Embodied energy stored in US soils.** Leibowitz, S.G. Jun 1979.

In Energy basis for the United States.

Part of the stored energy resources that support the US economy is the energy embodied in the soil. The embodied energy of a storage is the amount of energy required to generate that storage. Thus, the embodied energy of a unit of soil, in solar equivalents (SE), is the amount of kilocalories of solar energy that was needed to create that unit. Since man's activities increase the loss of soil through erosion, the economic base of our country is consequentially being weakened. The embodied energy of these losses can be compared to the losses of other storages of energy whose embodied energies are already known, such as fossil-fuels. The general procedure used to estimate the embodied energy in soil is described. A diagram illustrating the process of soil formation and loss is given. A broad soil classification was needed which would yield information on average soil nitrogen. It was therefore necessary to use soil types based on the great soil groups of the old system of soil nomenclature, rather than on the newer seventh approximation, since average nitrogen values were available for some of the soil types in this classification. Information on average soil nitrogen values of broad soil classes was not available for the rest of the country, so this paper only deals with the eastern two-thirds of the US. 10 references, 3 tables.

18915 (DOE/TIC—11131, pp 123-150) **Embodied energy in selected landforms.** Kangas, P. Jun 1979.

In Energy basis for the United States.

As part of the overall effort of evaluating the environment, a first attempt at calculating the embodied energy of selected landforms is made. Land is often taken for granted due to its vast extend and integral importance to the activities of man, but land and landform is the platform for human economies and terrestrial ecosystems. As a platform, land is an energy input to the processes and uses which take place upon it. The causality of landforms is addressed with calculations of the amount of energy embodied in them. Embodied energy is calculated as the total amount of energy needed to construct or generate a structure. In this sense, it is the total energy input (energy signature) multiplied by the time needed to develop the structure. This product is a measure of value similar to capital cost. Embodied energy calculations for sediments and for five landforms: sand dune, glacier, saltmarsh, floodplain and arroyo are included. 35 references, 8 tables.

18916 (DOE/TIC—11131, pp 151-208) **Energy embodied in climate.** Swaney, D. Jun 1979.

In Energy basis for the United States.

The energy and embodied energy inputs from climate to the United States and its contributions to agricultural production are evaluated. Solar insolation, rainfall, wind action, temperature, and humidity are well-known factors in regulating crop growth. Energy budgets of crops and forests have been studied intensively for many years, but contributions of climatic factors to the output and economics of agriculture have not been clear because individual climatic energies are of varying quality. Each energy source can be compared by representing all energy flows in embodied calories of sunlight. Production also depends on energy flow from important stored constituents in soil and water reservoirs, which are not included in this study. By mapping the spatial distribution of climatic variables over the US (in terms of their heat-equivalent energy flows) and applying energy-transformation factors (energy quality factors), indices of flows of potential energy were developed and related to observed agricultural production. The average embodied climatic energies for the US were then compared to the economic energies that can be attracted in the forms of labor, fuel, machinery and fertilizer, by calculating the embodied energy of their dollar value, and determining the investment ratio of economic inputs to climatic inputs. 63 references, 15 figures, 2 tables.

18917 (DOE/TIC—11131, pp 209-254) **Embodied energy in goods and services calculated from the 1967 input-output data including labor and government service feedbacks and solar energy inputs.** Costanza, R. Jun 1979.

In Energy basis for the United States.

The total energy cost of producing goods and services may be obtained by manipulating input-output statistics. To arrive at the total energy cost, two requirements must be met: (1) the total energy input to the economy must be specified (including the fossil fuel, mineral, and solar energy inputs), and (2) the system boundaries must be drawn so that only energy or embodied energy enters the system as an input. Some modifications to the current input-output accounting conventions which attempt to fulfill the latter requirement and some estimates of the solar energy inputs to the economy are presented in an attempt to make the former requirements more complete. The calculations are performed on a 90- and 92-sector model of the US economy for 1967 and results include the total fossil and solar energy intensities (in Btu/$ output) both separately and combined as the total fossil equivalents necessary to produce a dollar's worth of output in 1967. 24 references, 15 figures, 8 tables

18918 (DOE/TIC—11131, pp 255-258) **Simulation of retrenchment of assets with declining energy.** Odum, H.T.; Alexander, J.A.; Lemlich, S. Jun 1979.

In Energy basis for the United States.

Based on available energy sources known to human civilization, the current period of utilization of stored earth reserves in the building of human culture and assets is likely to crest and decline again, ultimately reaching some lower level based on the renewable energies. Although the majority of Americans have not really faced this likely reality, prudence and good science require considering this possible future trend quantitatively. The decline of assets, gross national product, energy flow, etc., can be called a period of retrenchment. Modeling studies of alternatives consider the maximum power principle as a possible guiding rule for a surviving system to meet all other contingencies by applying its superior energy resources as needed. The study of alternative models and examination of the observed processes and design of operational nature and of humanity have found two distinct kinds of patterns of growth and regression: (1) the decline is smooth, returning from the crest and leveling off with assets in steady-state balance between energy income and depreciation; and (2) the regression regards the downturn as the backside of a regular oscillation which is energetically successful because it maximizes power over both the short run and the long run. The system grows assets during its uptrend period because this maximizes competitive position by maximizing energy utilization.

18919 (DOE/TIC—11131, pp 259-319) **Power-maximizing energy-exchange simulation model with applications to the US economy-environment and the south Florida Region.** Costanza, R. Jun 1979.

In Energy basis for the United States.

US economy-environment and south Florida simulation models are described which were capable of approximating the historical behavior of the respective systems based on solar energy inputs and a power-maximizing decision structure. Due to the inherent difficulty of adjusting the models, no systematic parameter optimization was attempted. Therefore, the results cannot necessarily be considered as the best approximations of which these models are capable. The results do indicate the potential and some of the problems with this type of modeling, however. Generally, the simplest model capable of reproducing the system's behavior is considered to be the best. This is not necessarily true, however, if the criterion is general understanding of the system, and thus predictive ability. A more complete understanding of the system is possible with relativity. Newtonian mechanics represents a special case which is nonetheless very useful. The exponential growth model can be viewed as a special case of the more-general biological growth models applicable only during a limited phase of the growth cycle. In the same sense, the power-maximizing models developed in this study can be viewed as more general statements of biological growth models, intended to take into account evolutionary changes in the internal connectivity structure of the system. 9 references, 14 figures, 3 tables.

18920 (DOE/TIC—11131, pp 320-361) **Energy models of urban systems.** Brown, M.T. Jun 1979.

In Energy basis for the United States.

Our theoretical knowledge of the organization of complex systems is limited ... as is our knowledge of the energy embodied in urban structure. With a more complete understanding of complex system organization, behavior of these systems during times of changing energy availabilities may be predicted, and regional carrying capacities might be delineated. With a better understanding of the embodied energies in urban structure, decisions concerning the planning, building, and rebuilding of urban systems may be more enlightened concerning the energy commitments and life-cycle energy costs of proposed projects. Reported here are summary findings of various research endeavors concerning aspects of urban systems. First, empirical data are presented for various hierarchically organized complex systems observed in Florida. Second, a theoretical model of complex system organization is developed and computer simulations of changing energy conditions are generated to ascertain system behavior under such conditions. Third, the embodied energy in urban land uses, and the direct energy requirements for these land uses are calculated. 15 references, 18 figures, 5 tables.

18921 (DOE/TIC—11131, pp 362-368) **Procedure for energy analysis of a region or state.** Odum, H.T.; Odum, E.C.; Brown, M. Jun 1979.

In Energy basis for the United States.

A procedure is described for making an overview energy systems analysis of the economy of nature and humanity in an area of human settlement such as a county or state. (1) Using combined knowledge of advisors and references available, develop an energy diagram of the region, city, or state emphasizing all the natural and human driving forces that flow in across the border and the interactions and components that these generate within. Use the example given of a typical state as a guideline and checklist so as to include such main features as transportation, power plants, population, building assets, wilderness and fallow lands, agriculture, commerce, etc. (2) Evaluate the actual energies or dollars of the boundary flows, using energy quality factors multiply by the energy and dollar flows to get all flows in embodied coal equivalent Calories. (3) Draw a condensed diagram in which only the cross boundary values are given. From this, calculate ratios that help to indicate the role of the state as a producer, consumer, underdeveloped grower, or overdeveloped regressor, etc. (4) Make predictions about the economy of humanity and nature of that state. The future is examined for the rising relative price of energy due to declining net energy at home and abroad. 3 figures, 2 tables.

18922 (DOE/TIC—11131, pp 369-401) **Energy analysis of mesotechnology agro-ecosystems.** Burnett, M. Jun 1979.

In Energy basis for the United States.

Energy analysis was performed for three intermediate technology agro-ecosystems to understand food-production systems which are less dependent on fossil-fuel-based inputs. Detailed and aggregated energy-circuit models were evaluated in kilocalories. The three systems studied showed both ratios of food production to purchased feedbacks and ratios of food production to total energy inputs were nearly equal to or exceeded the US food system. The amounts of purchased feedbacks consumed per person were about one-third to one-sixth of the national average. 13 references, 11 figures, 3 tables.

18923 (DOE/TIC--11131, pp 430-444) **Using energy systems language to unify teaching of energy, environment, and economics.** Odum, H.T.; Odum, E.C. Jun 1979.

In Energy basis for the United States.

A concept of energy systems has been developed which unifies the teaching science fundamentals to show how they interact to shape the future. Symbolic energy-systems language is used to make network diagrams and to visualize relationships and trends. New inexpensive mini-computers can simulate behavior and provide the student with a sequence of learning steps. The short course described could be an important educational tool during the transition to a lower-energy future by helping people to understand what is happening and to plan for a changing world. 3 references, 7 figures.

18924 (ORNL—5277) **Computerized management report system for monitoring manpower and cost.** Bullington, V.R.; Stephenson, R.L.; Cardwell, R.G. (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 26p. Dep. NTIS, PC A02/MF A01.

Although most cost systems offer complete detail and traceability, not all provide timely detail in a concise form useful to senior management. This system was developed for a multifunction research organization funded from many sources. It extracts cost and manpower data from the general cost systems, summarizes it, compares it by program with previous cost periods, and presents it with minimum detail yet with maximum overview. The system monitors the basic manpower distribution of effort at the source, that is, the division time-card input. Cost data are taken from the central computer ahead of the print-out and report-distribution steps; thus, the summary information is available several days ahead of the detailed reports. This procedure has been regularly used for several months, and has proven to be a valuable tool in management action and planning. 9 figures.

18925 (UCRL—52508-79(Rev.1)) **Demonstration of the capabilities of the LLL energy policy model: 1979 update.** Anderson, C.J.; Castleton, R.N.; Coles, B.L.; Rambo, J.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Dec 1979. Contract W-7405-ENG-48. 118p. PC E $10.50/MF $4.25.

Lawrence Livermore Laboratory's Energy Policy Model (EPM) has evolved substantially since July 1978, when the first demonstration report was issued. In this report the authors discuss the updated base case and three sensitivity cases: a nuclear phase-out scenario, motivated by the incident at Three Mile Island in Harrisburg, PA; a scenario where oil imports are reduced dramatically, reflecting a possible government policy; and finally, a scenario with a limitation on coal production that could result from environmental concerns. Other recent work summarized in this report includes some preliminary results of an historical comparison project, which, to some extent, validates the EPM. Some issues regarding convergence of the model are examined, and some implications for regional analyses using the model are discussed. 19 references, 69 figures, 14 tables.

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 18388, 18541, 18542, 18910, 18917, 18919, 18920, 18935, 18936, 18946, 18953, 18955, 18960, 18962, 18967, 18980

18926 (CONF-781235—P1, pp 333) **Effects of conservation technology (technical fix) on the economy and energy resource use for the US.** Plass, H.J. Jr. (Univ. of Miami, Coral Gables, FL). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18927 (UT/CES-PS—9) **Energy, inflation, and citizen discontents: a report on public reasoning about electric utility policies and nuclear energy.** Denney, W.M.; Hendricks, J.S. (Texas Univ., Dallas (USA). Center for Energy Studies). Dec 1979. Contract EX-77-S-01-6077. 10p. Dep. NTIS, PC A02/MF A01.

This is the second and final report of a year-long exploratory study of public opinion about energy and inflation problems in this country. Whereas the first project report (Hendricks and Denney 1979) dealt broadly with the nature of public reasoning about energy and inflation issues, this report focuses on narrower and somewhat more-concrete manifestations of these issues. The focus of this report is twofold: (1) public experiences and sentiments about the local electric utility; and (2) public reasoning about nuclear energy, including analysis of the impact of Three-Mile Island. Data for this report come mainly from telephone surveys of citizens of Austin, Texas. Austin is a prosperous, rapidly growing sunbelt city, with a municipally owned electric utility and a recent history of public controversy surrounding the utility, rising electric rates, and related municipal policies. The fact that Austin has unusually high electric rates, combined with a newly adopted peak seasonal rate structure which results in higher summer rates, makes it a forerunner for conditions that may soon be experienced by other cities in this country. Also, Austin voted on April 7, 1979, ten days after the Three-Mile Island accident, in favor (53% majority) of a bond

proposition to raise $160 million to maintain the city's 16% share in the Mammoth South Texas Nuclear Project (STNP). 13 references, 20 tables, 3 figures.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 18831, 18911, 18919, 18932, 18937, 18950, 18951, 18952, 18956, 19036, 19216, 19237

18928 (CONF-7804163—(Vol.1), pp 175-178) **Role of science and technology in development.** Arnold, H.A. (Agency for International Development, Washington, DC). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Science and technology, including engineering, biological sciences and management, provide knowledge and techniques essential for the development of a country's people; for the prudent management of its natural resources and environment; and for the provision of goods and services which sustain society and enhance the quality of life. The role of science and technology in the development of countries is simultaneously overestimated and underestimated. Scientists and engineers need to learn more about the multifaceted nature of the important problems impeding development if they are to apply science and technology in a rational and appropriate manner. Ways in which science and technology can expedite or facilitate the development process and means by which science and technology can be put to use more effectively are discussed.

18929 (CONF-7804163—(Vol.1), pp 213-218) **Transfer of remote sensing technology for the benefit of developing countries: a case study in Bangladesh.** Hossain, A. (Bangladesh Landsat Programme, Dacca). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Remote sensing technology has been used in Bangladesh in the fields of agriculture, water resources, forestry, and land-use planning. A few examples of the experience gained by Bangladesh LANDSAT Programme in these fields are cited. A few case studies on the social impact of development programme as a by-product of the field activities of Bangladesh LANDSAT Task Force are discussed. These might be examples for other countries of the world.

NATURAL RESOURCES

REFER ALSO TO CITATION(S) 18912, 18913, 18918, 18948, 18954, 18955

18930 (CONF-781235—P1, pp 325-328) **Making a reality of alternatives: a state perspective.** Veigel, J.M. (California Energy Commission, Sacramento). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18931 (CONF-781235—P1, pp 335-341) **Interfacing political realities, societal goals, and practical engineering.** Smith, O.J.M. (Univ. of California, Berkeley); Smith, P.S. 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18932 (DOE/TIC—11131, pp 402-429) **Energy analysis of ecological succession as a reclamation alternative for phosphate mining.** Kangas, P. Jun 1979.

In Energy basis for the United States.

The author describes natural succession on phosphate spoil mounds in central Florida and energy analysis of succession as a reclamation alternative. Large areas of old spoil mounds are found in the central phosphate district in various stages of succession. A current issue is whether or not these lands need to be reclaimed and, if so, how far back in time is reclamation required. The purpose of this study was to assess the need for additional reclamation on old spoil mounds where succession has operated for various lengths of time and to investigate succession as a reclamation alternative for newly mined lands. 44 references, 4 figures, 8 tables.

RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIALIZATION

REFER ALSO TO CITATION(S) 18958, 19216

18933 (CONF-800505—1) **QA management approach unique to R and D programs.** Beaver, R.J.; Weir, J.R. Jr. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-48. 7p. Dep. NTIS, PC A02/MF A01.

From 34. annual technical conference of the American Society for Quality Control; Atlanta, GA, USA (20 May 1980).

The approach to the current quality assurance management of the Metals and Ceramics Division at ORNL is discussed. The organization disciplines interrelate with the QA programming. Procedure QA-MC-1-100 defines control of experimental tasks, which represent about 90% of the Division's work. Procedure QA-MC-1-106 defines action plans for projects. The QA coordinator, independent of line management, communicates, audits, and reviews to assist line management in the understanding and acceptance of the Division QA procedures. (MCW)

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 18415, 18927

18934 (AAEC/E—451) **Net fossil energy savings for alternative mixes in various electric supply systems.** Essam, P.; Stocks, K.J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1978. 52p. Dep. NTIS (US Sales Only), PC A04/MF A01.

The actual and projected electric power station building programs of several countries and regions have been examined to determine what effect the introduction of nuclear power has on fossil fuel usage by the electricity system. It was found that (1) nuclear power leads directly to savings in fossil fuel usage, a larger nuclear component leading to larger savings; (2) individual nuclear stations rapidly wipe out the energy 'debt' incurred during building; and (3) the relatively short periods of consolidation in the early stages of a nation's building program usually prevent the nuclear component from going into energy 'debt'. Assessments of the energy requirements to build and run various types of power station have been made from the available literature.

18935 (DOE/EIA—8558/7(Vol.2)) **Capital Requirements Estimating Model (CREMOD) for electric utilities. Volume II. User's manual.** Collins, D.E.; Gammon, J.; Shaw, M.L. (Logistics Management Inst., Washington, DC (USA)). Jan 1980. Contract EM-77-C-01-8558. 60p. Dep. NTIS, PC A04/MF A01.

This volume, Vol. II, describes specific data requirements and operating procedures for CREMOD. When CREMOD is accessed by the user, its program control module requests the user to choose which one of the following seven alternative model functions s/he wishes to use: (1) Compute Capital Requirements (CCR); (2) Display BUILD Limits (DBL); (3) Revise/Display Plant Type Master File (RMF); (4) Revise/Display Capital Coefficients (RCC); (5) Revise/Display Capital Expenditure Profiles (RCE); (6) Display Interim MEFS Solution Files (DMS); (7) Stop.

18936 (DOE/EIA—8558/7(Vol.3)) **Capital Requirements Estimating Model (CREMOD) for electric utilities. Volume III. User's manual appendices: program and input data listings.** Collins, D.E.; Gammon, J.; Shaw, M.L. (Logistics Management Inst., Washington, DC (USA)). Jan 1980. Contract EM-77-C-01-8558. 119p. Dep. NTIS, PC A06/MF A01.

This volume, Vol. 3, is an extension of Vol. 2, User's Manual, containing listings of the computer program and input data for the model in two appendices. It serves the user as a reference guide to the computer model. This documentation complies with the Interim Model Document Standards issued by the Office of Analysis, Oversight, and Access of the Energy Information Administration in December 1978.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 18902, 18911, 18912, 18913, 18914, 18915, 18916

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 18994, 19028, 19030, 19031

CONSERVATION

REFER ALSO TO CITATION(S) 18978, 18985, 18987, 18989, 18990, 18991, 18992, 18995, 18998, 19000, 19002, 19011, 19015, 19020, 19023, 19027, 19036, 19037, 19038, 19039, 19040, 19041, 19042, 19043, 19044, 19045, 19046, 19047, 19048, 19049, 19050, 19051, 19052, 19053, 19054, 19055, 19056, 19057, 19058, 19059, 19060, 19061, 19062, 19063, 19064, 19065, 19066, 19067, 19068, 19069, 19070, 19071, 19072, 19073, 19074, 19075, 19076, 19077, 19078, 19079, 19080, 19081, 19082, 19083, 19084, 19085, 19086, 19088, 19089, 19222, 19223, 19224, 19225, 19226, 19227, 19228, 19229, 19230, 19231, 19232, 19233, 19234, 19235, 19236, 19237, 19238, 19239, 19240

18937 (CONF-781235—P1, pp 89-90) **Energy conservation's environmental impacts barriers to commercialization.** Gordon, R. (Donovan, Hamester and Rattien, Inc., Washington, DC). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18938 (CONF-7805138—P2, pp 1-6) **Public policy considerations and earth-covered settlements.** Hamburger, R. 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

Public policies that encourage energy conservation by promoting earth-covered buildings will work best if they reinforce each other. Conflicting policies, such as those providing solar-energy incentives, must either be reconciled or a choice made. Building-performance codes could maximize energy efficiency and also provide incentives for earth-covered buildings. Policies that provide subsidies for a specific technology will not be as productive as policies that reward accomplishment, in this case conservation. Even reinforcing policies may conflict over resources, financing, land use or other areas and need to be reexamined for their relevance to the policy goal. 6 references. (DCK)

18939 (CONF-7805138—P2, pp 7-11) **Institutional constraints on the marketing and financing of earth-covered settlements.** Isakson, H.R. (Washington State Univ., Pullman). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

Artificial barriers will impede the marketing of earth-covered settlements, however economically viable they may be. Among the constraints the real estate market will face are: a emphasis on front-end costs, which distorts life-cycle costs; utility pricing, which disguises the savings value of earth-covered settlements; academic and business specialization in preference to multidisciplinary approaches; excessive optimism that technology will find a way to avoid life-style changes; inadequate information; and a reluctance for financing unproven earth-covered structures. Some of these constraints will be met by the HUD's Experimental Housing Program and by new criteria for real estate lenders to include anticipated operating costs when evaluating borrower eligibility. Building performance standards and public awareness will also provide strong incentives to finance underground structures. (DCK)

18940 (CONF-7805138—P2, pp 12-16) **City Hall's response to a proposed subterranean dwelling.** Miller, J.R. 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

Mr. Miller briefly describes Los Alamos City Hall's response to his request in November 1977 for permission to construct a subterranean home. The home would use solar heating and natural, nonmanufactured materials and would be similar to dwellings in the north canyon walls around Los Alamos built 700 years ago. The lot chosen is a canyon rim lot that steeply rises 35 ft from the street to the canyon rim. The lot material is solid tuff right to the surface. Two 12-ft-wide tunnels joined by cross shafts would provide the dwelling space. The space extends to the canyon wall, where vertical glass windows would be installed for passive solar heating. Arched ceilings, doorways, and tuff columns would provide the necessary structural support. In addition to needing city permission to construct the dwelling, permission is also needed to tunnel through to the canyon walls for the windows. The request brought stiff opposition from City Hall, while citizens' commissions were enthusiastic. Unexpected press coverage ensued and City Hall, in their bafflement, referred the proposal to a state agency, the New Mexico Construction Industries Commission, which gave unanimous approval in a public hearing. City Hall then wrote a letter to the International Conference of Building Officials. Mr. Miller was still awaiting permission to build at the time of this meeting.

18941 (CONF-7805138—P2, pp 17-24) **Social issues in community planning for earth-covered shelter.** Davidoff, L. (Suburban Action Inst., New York City, NY). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

The Suburban Action Institute has dealt with many of the exclusionary zoning issues which will confront planners who see earth-covered settlements as a viable way to conserve energy. The issue of access to locational choice can bring together those whose concerns have been focused on social or environmental concerns in a coalition of support for innovative change. The opportunity for a broader range of housing choices is suggested as a way to interest citizens and public officials in earth-covered housing as, not only an energy-conservation strategy, but a way to enhance the urban environment. Four specific social benefits suggested are: (1) high population density without apparent crowding of units; (2) separation of pedestrian from vehicular traffic; (3) life-cycle cost reduction; and (4) less apparent status differentiation among dwelling units. (DCK)

18942 (CONF-7805138—P2, pp 25-29) **Building codes and underground buildings.** Green, M. 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

Current building codes, which are historically set to promote public health, safety, and welfare, may present some problems in the area of underground structures. The model building codes most commonly used are criticized by many for constraining innovative and less-costly construction methods. The producers of new building materials, design professionals, and building officials themselves are pressing for new procedures for adopting and modifying the codes to take account of energy-conservation requirements. Underground buildings will be primarily affected by the codes governing accident prevention, health and hygiene, structural stability, and fire and life safety. The main concern is over egress and the behavior of research into code requirements should lead to the development of code procedures that are responsive to technological changes. (DCK)

18943 (CONF-7805138—P2, pp 30-41) **Process for translating user needs and physical and administrative constraints into performance codes and specifications for underground facilities.** Hattis, D.B. (Building Technology, Inc., Silver Spring, MD). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

A systems framework is presented which is aimed at providing a status report on the current underground building technology, a guideline for resource allocation, and a base for coordinating codes and standards that will expedite the process of introducing a new technology. The building-performance specifications developed for the Iranian Housing Ministry by Building Technology, Inc. are used to illustrate how a short-term data analysis can produce a generic description of all the building technologies available to laymen to use in construction. The three-phase process is divided into accumulating user, physical, and administrative data; analyzing generic building parts, performance and interface data; and synthesizing code and performance statements. (DCK)

18944 (CONF-7805138—P2, pp 42-43) **High cost of saving energy.** Patterson, W. (Univ. of Texas, Arlington). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

Economic considerations and financing guidelines are combining to make it difficult to get energy-saving houses on the market. Present mortgage practices do not consider the life-cycle savings available with energy-saving features. Lenders who do consider the future energy needs of a building are increasing the appraised value of energy-efficient homes and evaluating prospective buyers on their ability to meet energy costs. Builders still feel obligated, however, to add high-cost amenities, which excludes many potential buyers. A more appropriate procedure for qualifying buyers is described as a solution to break this impasse. (DCK)

18945 (CONF-7805138—P2, pp 54-70) **Comments on the finance of earth-covered dwellings.** 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

The comments of six specialists summarize the problems of financing earth-covered homes and the larger problem of introducing technological change into traditional value systems. Edited portions of the group's discussion address the problems of the utility's role in pricing and risk sharing, the expected stability of future energy costs, the true costs of energy conservation, conflicting impediments to technological advances, how to allocate risks, and financing options for underground buildings. (DCK)

18946 (CONF-7805138—P2, pp 71-77) **Psychological aspects of earth-covered buildings.** Bechtel, R.B. (Univ. of Arizona, Tucson). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

The literature on earth-covered buildings indicates a need for more research on the problems of image and life style. The negative stereotypes discussed in the literature can be modified if a program to promote underground housing makes use of post-occupancy evaluations to derive a set of building-performance criteria. Many of the negative expectations attached to underground living can be removed by education and the recognition that natural sunlight and outdoor sounds are important. Lending institutions are reluctant to finance these houses, but their attitude will change with marketing

experience. If attention is given to the specific life-style needs of resident groups by age, occupation, culture, and other categories, building specifications can be made that will be acceptable. 19 references. (DCK)

18947 (CONF-7805138—P2, pp 78-81) **Community and building official reaction to earth-covered buildings: a case study of Terraset Elementary School, Reston, Virginia.** Carter, D.N. (Davis, Smith and Carter, Reston, VA). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

The proposal to build an earth-covered elementary school in Reston, Virginia was met with a variety of reactions from designers, cost consultants, public officials, and private citizens, especially the building's users. A review of these reactions is presented as a guide to future designers who wish to avoid as many pitfalls as possible. The experience in Reston was positive enough to warrant a commission for a second school, which will build on the 70 to 75% energy savings of the first by simplifying the operation and maintenance of the mechanical system. (DCK)

18948 (CONF-7805138—P2, pp 82-93) **Personal change in the conceptual use of land as related to earth-covered housing.** Cargo, D.B. (Univ. of Texas, Richardson). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

The use of open or unrestricted land around and on top of earth-covered housing may mean that residents will need to make personal changes in the ways in which they use and view land. A brief history is given of the concepts and use of open space. The problems of space perception are described and a personal account given of how open space was used by residents of two different communities designed around greenbelts schemes. The paper concludes by proposing some of the land-management restrictions and basic philosophic attitudes towards land that may need to be changed for earth-covered housing areas. 11 references.

18949 (CONF-7805138—P2, pp 94-107) **Life-cycle-cost comparison between a conventional and an earth-covered home.** McWilliams, D.B.; Findley, S.M. (Univ. of Texas, Arlington). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

A life-cycle-cost comparison is made between an earth-covered and a conventional house to see if the energy and maintenance savings of underground housing are enough to justify the higher initial cost. All other costs are assumed to be the same. Home buyers interested in a long-term payoff will find the earth-covered home has an economic advantage, but many buyers are more concerned with short-term marketability. If initial construction costs can be lowered or if the rate of energy cost inflation increases, the economic feasibility of earth-covered houses will improve. The first houses can be expected to be undertaken on a contract rather than speculative basis until a market develops. 8 tables. (DCK)

18950 (CONF-7805138—P2, pp 108-124) **Earth-covered housing: hydrologic and pollution considerations.** Foute, S.J.; Cargo, D.B. (Univ. of Texas, Richardson). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

The hydrologic and pollution loading differences between conventional medium- and high-density communities and earth-covered medium- and high-density communities are compared. The pollutants considered are five-day biochemical oxygen demand, total suspended solids, total nitrogen, and total phosphorus. As a result of this study, it was determined that the kind of pollutants do not change in the transition to the earth home, but rather only magnitudinal differences are noticed. Emphasis is placed on the contributing factors relative to the rate of soil erosion, and pollution concentrations in terms of runoff. Solutions are proposed to some problems of construction and development. 17 references, 1 figure, 9 tables.

18951 (CONF-7805138—P2, pp 125-140) **Performance of earth-covered development: planning issues.** Labs, K.B. (Bucks County Planning Commission, Mechanicsville, PA). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

The benefits of underground housing on a community and regional scale are discussed as a guide to development planning. Earth-covered buildings conserve energy and reduce the environmental impacts of housing only if the construction is carefully planned to accomplish these goals. Architects and site planners need to work with builders and developers to identify the areas where the thermal environment is appropriate for subsurface building. Site planning needs to consider the effects on stormwater runoff, aesthetic and cultural values, ambient temperatures, and compatible landroof uses without assuming that subsurface construction will automatically be beneficial. 18 references, 5 figures. (DCK)

18952 (CONF-7805138—P2, pp 141-148) **Catastrophe theory and the acceptance of underground space.** Meier, R.L. (Univ. of California, Berkeley). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

A catastrophe may provide the push needed to motivate people to live underground in spite of negative images in the public mind. The shock of a catastrophe can sometimes break down the preconceptions and institutional barriers that make the introduction of new technology difficult. The application of catastrophe theory is examined, and a method is proposed that would promote underground housing on the basis of safety, with energy conservation as a secondary benefit. Post-catastrophe publicity given to the advantages of underground living would introduce a positive image and subsequent acceptance. 5 references. (DCK)

18953 (CONF-7805138—P2, pp 149-151) **Design considerations for the elderly and handicapped.** Powell, E.J. 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

Settlements of earth-covered houses designed to meet the needs of elderly and handicapped people would be an economical and practical way to provide appropriate housing without removing these groups from the neighborhood. Properly-designed structures would eliminate unnecessary barriers and inconveniences and still accommodate a range of ages and life styles. A plan for developing mini-condominiums in established neighborhoods is suggested as a way to virtually eliminate many handicap problems that are aggravated by conventional architecture. (DCK)

18954 (CONF-7805138—P2, pp 152-168) **Development of underground space.** Aughenbaugh, N.B. (Univ. of Missouri, Rolla). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

It is technically feasible to develop space underground for housing, storage, industry, utilities, and commercial enterprises. The many benefits include relatively cheap construction, energy conservation, protection from surface hazards, additional aggregate supply, aesthetics, and three-dimensional land use. Man has the technology to construct stable underground space in most geographic areas. However, the local topography and geology are major factors that will control the site location, type of construction, general feasibility and economics for any proposed underground development. Underground space can be developed entirely in rock, in soil, or in soil-rock combinations. Depending upon the type of material and the depth beneath the surface, construction techniques will vary from conventional underground mining to cut-and-backfill practices. Underground space can be developed for total isolation or with various interfaces to the surface both laterally and vertically. 6 references, 10 figures.

18955 (CONF-7805138—P2, pp 169-173) **Projections on the future of underground development.** Mason, R. 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

The future of earth-covered buildings is related to the future of population growth, the capacity of urban areas to remain viable, and the development of new technologies, new materials, and new energy sources. Some recent developments in building systems designs are cellular structures, bridge structures and container structures. Future possibilities could include marine structures, space colonization, and are biogenesis. The appeal of underground housing as part of the ecology movement is a response to man's increasing destruction of the earth's surface and the need to reduce energy consumption. The prospects for terratectural designs for all types of buildings are good because the concept is compatible with urban-development projections. (DCK)

18956 (CONF-7805138—P2, pp 174-202) **Subterranean settlements for arid zones.** Golany, G. (Pennsylvania State Univ., University Park). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

Earth-covered settlements that combine ancient energy-free cooling methods and modern construction technology are particularly appropriate for low-income people in arid areas. Focusing on the hot and dry lands of the equatorial regions, the author suggests incorporating the ancient systems of subterranean placement, passive ventilation, and cooling by evaporation. A variety of settlement plans are suggested to show how these three cooling methods can take advantage of modern planning and development for flat or sloping terrain. It is important for planners/developers to understand the costs and benefits involved so that they can promote the concept on the strength of their own conviction. 27 references, 10 figures. (DCK)

18957 (CONF-7805138—P2, pp 203-240) **Notes on the underground.** Bennett, D.J. (Myers and Bennett, Minneapolis, MN). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

Underground and earth-sheltered buildings will be one way in which architecture during the end of the 20th century focuses more on emulating than trying to overcome nature. Background information on Williamson Hall on the University of Minnesota campus, the Fort Snelling Visitor Center, and the Walker Community Library illustrate efforts in Minnesota to design and plan earth-sheltered buildings. Consideration was given to established traditions and symbols, the psychological and energy contributions of sunlight, access to and movement within the structure, and the use of urban space for public activities. The structures make use of solar energy for heating and cooling in addition to the natural temperature-moderating and storage effects of the earth. The experience gained in designing and engineering these structures can be applied to other energy-efficient public buildings. (DCK)

18958 (CONF-7805138—P2, pp 278-355) **Notes on earth-covered settlements.** Moreland, F.L. (Moreland Associates, Fort Worth, TX). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

Several alternative plans are developed for the construction of earth-covered neighborhoods in Fort Worth, Texas, which has already shown interest in the concept by accepting plans for an elementary school, a public library, and a demonstration of four homes. Alternative housing studies examining the costs of housing designs and bus transportation at different population densities suggest that earth-covered houses at a medium density have many environmental, health, and cost advantages. Several variations are shown for patio houses and a hill village. Other studies have explored the possibilities of alternative energy sources and land use in conjunction with underground housing. The potential for this type of development to enhance urban life might warrant a major national program to restructure cities. 82 figures. (DCK)

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 18910, 18925, 18930

18959 (AD-A—068571) **Siberian development and its implications for the USSR. Final report.** Kimmel, L.J. (Army Military Personnel Center, Alexandria, VA (USA)). 2 Oct 1978. 115p. NTIS, PC A06/MF A01.

This report deals with the energy and resource potentials of the USSR with emphasis on the present and future Siberian developments. An extensive discussion is included of what is presently existing in the Siberian industrial base and the proposed expansion of the Siberian territorial production complexes (including what the proposed sites will produce and at what scale). A cost benefit analysis of the energy production and transmission schemes is compared to the movement of labor and infrastructure from the W. USSR to Siberia.

18960 (DOE/EIA—0183/17) **Short-Term Integration Forecasting System (STIFS) forecast validation procedures.** Hopkins, F. (Department of Energy, Washington, DC (USA). Energy Information Administration). Mar 1980. 45p. Dep. NTIS, PC A03/MF A01.

The Short-Term Integrated Forecasting System (STIFS) is a computerized data base and forecasting module integrating system that generates monthly national forecasts of approximately 114 energy variables for a period of from 12 months to 36 months. The individual fuel forecasts are generated using econometric, time series of judgmental approaches. This paper contains a description of: STIFS, system structure, data, and the procedures that will be used to validate the accuracy of the forecasts.

18961 (DOE/EIA—0202/2) **Short-term energy outlook.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Feb 1980. 230p. GPO$4.00.

EIA published an Analysis Report, Short-Term Energy Outlook, October 1979 (DOE/EIA—0202/1; EAPA 6: 837) which was the first to use the Short-Term Integrated Forecasting System (STIFS), developed at EIA. It provided quarterly projections for 1979 and 1980 for all energy products and monthly projections of motor-gasoline and distillate-fuel-oil supply and disposition. The October report was designed to analyze important new developments in the petroleum sector, such as the mid-year OPEC price increases, the spring gasoline shortage, the distillate-fuel-oil stock build-up, and the recent Presidential decisions to accelerate decontrol of domestic-crude-oil prices and to limit the volume of US petroleum imports. The impact of these developments in the petroleum sector on non-petroleum products was analyzed within the STIFS framework. This report provides revised, quarterly projections for 1980 and the first quarter of 1981 for all major energy products, and it provides monthly projections for gasoline and distillate fuel oil. The revised projections take into account recent and anticipated developments affecting the domestic energy situation, such as the latest OPEC pricing policy and the Nuclear Regulatory Commission decisions on nuclear power. The forecast also reflects recent changes in the economic outlook and changes in the outlook for domestic energy production.

18962 (DOE/EIA—0206(77)) **Performancpe profiles of major energy producers, 1977.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jan 1980. 192p. Dep. NTIS, PC A09/MF A01.

This volume is the first report of the Financial Reporting System (FRS). The finances and economics of energy production are the main subjects addressed by the data gathered. Much information already exists because of the largest firms are publicly held and file reports with the SEC. Useful as these reports are, they leave much to be desired as an account of the financial and economic aspects of the energy industry in the United States. Chapter 2 compares the 26 companies reporting to the FRS with a broad index of companies which includes energy companies and other non-energy industrial companies. The comparisons are at the aggregated consolidated company level where public information is available. In Chapter 3, characteristics of the industrial financial structure are reviewed in the context of the FRS reporting framework. Data on horizontal diversification are presented to permit review of existing patterns and evident directions of change, as well as the relation of these patterns to firm and segment profitability. In Chapter 4, profits, new investments, and the composition of net investment in place are described by FRS size groupings. Chapter 5 traces oil and gas resource-development efforts in 1977. Data on resource-development expenditures are complemented by data on reserve holdings, changes in reserves, and characteristics of exploration and development effort. Foreign activity is compared with domestic. Chapter 6 deals specifically with crude and refined-product production and distribution.

18963 (WAOENG—79-2) **Review of current energy forecasts for the state of Washington.** Hinman, G. (Washington State Univ., Pullman (USA). Environmental Research Center). Dec 1979. 74p. Washington State Energy Office, Olympia.

This report is a review of several forecasts of energy demand, supply, and prices for the state of Washington. It is not a critique of methodologies used but a description of the forecasts and some of their implications. The current energy situation in the state is described first, including two serious problem areas. Then five comprehensive state forecasts, and two other related forecasts, are introduced and compared. Finally, the plans for new facility construction are reviewed. The report focuses on conventional energy supplies, including conventional hydropower. Solar energy in its various forms, geothermal, and other alternative energy sources are not included. Alternative energy supplies are not expected to play a major role by the year 2000 in any of the five forecasts reviewed. An addendum to the report describes some forecasts made by the Energy Information Administration. 20 references, 9 figures, 18 tables.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 18389, 18405, 18550, 18640, 18701, 18794, 18925, 18931, 18940, 19037, 19038, 19039, 19040, 19041, 19042, 19043, 19044, 19045, 19046, 19047, 19048, 19049, 19050, 19051, 19052, 19053, 19054, 19055, 19056, 19057, 19058, 19059, 19060, 19061, 19062, 19063, 19064, 19065, 19066, 19067, 19068, 19069, 19070, 19071, 19072, 19073, 19074, 19075, 19076, 19077, 19078, 19079, 19080, 19081, 19082, 19083, 19084, 19085, 19086

18964 **Outer Continental Shelf Lands Act Amendments of 1978 [to accompany S. 9], House of Representatives, Ninety-Fifth Congress, Second Session, August 10, 1978.** Washington, DC; House of Representatives (1978). 161p. GPO.

The conference report from the House of Representatives on the Outer Continental Shelf Lands Act Amendments of 1978 is presented. The amendments establishes a policy for: the management of oil and natural gas in the outer continental shelf; protection of the marine and coastal environment; amendment of the Outer Continental Shelf Lands Act. (DC)

FOSSIL FUELS

REFER ALSO TO CITATION(S) 18963

COAL

REFER ALSO TO CITATION(S) 18358

18965 (DS-I—1979-9) **Possibilities for increased coal use in Sweden: a report from the delegation for oil substitution.** (Industridepartementet, Stockholm (Sweden)). Oct 1979. 284p. (In Swedish). Dep. NTIS (US Sales Only), PC A13/MF A01.

The possibilities for increasing the use of coal in Sweden are investigated, especially for electricity generation in case of a shutdown of the nuclear power plants. The use of coal in industry and for space heating are more briefly treated. The entire handling systems, from importing to combustion and environmental effects are discussed. It is concluded that the coal handling systems in Sweden can be developed to allow an import of about 20 Mtons/y in the beginning of the 1990s.

PETROLEUM

REFER ALSO TO CITATION(S) 18388, 18389, 18961, 18965

NATURAL GAS

REFER ALSO TO CITATION(S) 18404, 18405

HYDROGEN AND SYNTHETIC FUELS

REFER ALSO TO CITATION(S) 18902

ELECTRIC POWER

REFER ALSO TO CITATION(S) 18927, 18963

18966 (CONF-781235—P1, pp 7-9) **Impact of electric utility rate restructuring on residential solar and conservation design criteria.** Johnson, K.E. (Donovan, Hamester and Rattien, Inc., Washington, DC). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18967 (DOE/EIA—8558/7(Vol.1)) **Capital Requirements Estimating Model (CREMOD) for electric utilities. Volume I. Methodology description, model, description, and guide to model applications.** Collins, D.E.; Gammon, J.; Shaw, M.L. (Logistics Management Inst., Washington, DC (USA)). Jan 1980. Contract EM-77-C-01-8558. 98p. Dep. NTIS, PC A05/MF A01.

The Capital Requirements Estimating Model for the Electric Utilities (CREMOD) is a system of programs and data files used to estimate the capital requirements of the electric utility industry for each year between the current one and 1990. CREMOD disaggregates new electric plant capacity levels from the Mid-term Energy Forecasting System (MEFS) Integrating Model solution over time using actual projected commissioning dates. It computes the effect on aggregate capital requirements of dispersal of new plant and capital expenditures over relatively long construction lead times on aggregate capital requirements for each year. Finally, it incorporates the effects of real escalation in the electric utility construction industry on these requirements and computes the necessary transmission and distribution expenditures. This model was used in estimating the capital requirements of the electric utility sector. These results were used in compilation of the aggregate capital requirements for the financing of energy development as published in the 1978 Annual Report to Congress. This volume, Vol. I, explains CREMOD's methodology, functions, and applications.

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 18831

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 18921, 18922

UNCONVENTIONAL SOURCES AND POWER GENERATION

REFER ALSO TO CITATION(S) 18911, 18914, 18915, 18916

SOLAR

REFER ALSO TO CITATION(S) 18541, 18542, 18545, 18546, 18555, 18557, 18559, 18613, 18614, 18640, 18701, 18730, 19234, 19235

OTHER

REFER ALSO TO CITATION(S) 18598

ENERGY CONVERSION

MHD GENERATORS

18968 **Advances in MHD technology.** Petrick, M. (Agronne National Lab., IL). pp 635-678 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

The prospects for improved utilization of coal in HMD and other systems for the production of electricity have been investigated recently in a comprehensive study - the Energy Conversion Alternatives Study (ECAS). A number of US federal and private organizations participated in the study and evaluated, with a common set of specifications and ground rules, many concepts for advanced central station power plants fired by coal or coal-derived fuel. This study is considered the most definitive to date in establishing the economic potential of an open-cycle MHD plant and in comparing it to other alternatives. In the first of three phases in the ECAS, ten types of power plants were analyzed parametrically: three types of MHD systems (open-cycle, closed-cycle, and liquid-metal), two open-cycle turbine systems (simple and combined cycle), four closed-cycle turbine systems (advanced steam, gas turbine, liquid-metal Rankine, and supercritical CO_2), and fuel cells. On the basis of the parametric results, and open-cycle MHD/steam plant was selected for conceptual design and for assessment of the resources required to implement development of the first commercial plant. The Phase 1 and 2 studies both showed that open-cycle, coal-fired MHD power plants have the potential for very high efficiency and relatively low cost of electricity.

MATERIALS, COMPONENTS, AND AUXILIARIES

18969 **Magnetohydrodynamic (MHD) channel corner seal.** Spurrier, F.R. US Patent Application 018,099. [nd]. 7p.

A corner seal for an MHD duct includes a compressible portion which contacts the duct walls and an insulating portion which contacts the electrodes, sidewall bars and insulators. The compressible portion may be a pneumatic or hydraulic gasket or an open-cell foam rubber. The insulating portion is segmented into a plurality of pieces of the same thickness as the electrodes, insulators and sidewall bars and aligned therewith, the pieces aligned with the insulator being of a different size from the pieces aligned with the electrodes and sidewall bars to create a stepped configuration along the corners of the MHD channel.

THERMIONIC CONVERTERS

18970 (PPPL—1649) **Analysis of electron transport in the plasma of thermionic converters.** Stoenescu, M.L.; Heinicke, P.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1980. Contract EY-76-C-02-3073. 43p. Dep. NTIS, PC A03/MF A01.

Electron transport coefficients of a gaseous ensemble are expressed analytically as function of density, and are expressed analytically as function of temperature up to an unknown function which has to be evaluated for each specific electron-neutral atom cross section. In order to complete the analytical temperature dependence one may introduce a polynomial expansion of the function or one may derive the temperature dependence of a set of coefficients, numbering thirteen for a third approximation transport evaluation, which completely determine the transport coefficients. The latter approach is used for determining the electron transport coefficients of a cesium plasma for any ion neutral composition and any temperature between 500°K and 3500°K. The relation between the transport coefficients of a fully and partly ionized gas is readily available and shows that, in the classical formalism, electron-ion and electron-neutral resistivities are not additive. The present form of the transport coefficients makes possible an accurate numerical integration of transport equations eliminating lengthy computations which are frequently inaccessible. It thus provides a detailed knowledge of spatial distribution of particle and energy transport and makes possible the determination of one of the three internal voltage drops, surface barrier, sheath and plasma, which are linked together experimentally by current density versus voltage characteristics of thermionic converters.

PERFORMANCE AND TESTING

18971 (DOE/NASA/1062—80/5) **Potentialities of TEC topping: a simplified view of parametric effects.** Morris, J.F. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1980. Contract EC-77-A-31-1062. 21p. Dep. NTIS, PC A02/MF A01.

Reductions in the cost of thermionic-energy-conversion (TEC) modules yield direct decreases in cost of electricity (COE) from TEC-topped central-station power plants. Simplified COE, overall-efficiency charts presented illustrate this trend. Additional capital-cost diminution will result from designing more compact furnaces with considerably increased heat-transfer rates allowable and desirable for high-temperature TEC and heat pipes. Such improvements can evolve because of the protection from hot corrosion and slag as well as the thermal-expansion compatibilities offered by silicon-carbide clads on TEC-heating surfaces. Greater efficiencies and far fewer modules are possible with high-temperature, high-power-density TEC: This will decrease capital and fuel costs much more - and substantially increase electric-power outputs for fixed fuel inputs. In addition to more electricity, less pollution, and lower costs, TEC topping used directly in coal-combustion products will contribute to balance-of-payment gains and national energy independence.

FUEL CELLS

MATERIALS, COMPONENTS, AND AUXILIARIES

18972 (AD-A—068433) **Development program for 3.0 kW inverter. Militarized inverter for use with fuel cell or battery power plants. Final report, December 1976—December 1978.** Rance, J.E. (Gulton Industries, Inc., Hawthorne, CA (USA). Engineered Magnetics Div.). 15 Jan 1979. Contract DAAK70-77-C-0012. 24p. NTIS, PC A02/MF A01.

This report describes the design, construction and testing of a static inverter rated at 3.0 kilowatts. Circuit techniques were evaluated to obtain desired results with considerations to cost, reliability, maintainability, weight, size and efficiency. The application of this portable, rugged inverter is to replace mechanical alternating generators used in the field.

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 18536

BUILDINGS

REFER ALSO TO CITATION(S) 18664, 18669, 18938, 18939, 18941, 18942, 18943, 18947, 18951, 18954, 18955, 18956, 19222, 19223, 19224, 19225, 19226, 19227, 19228, 19229, 19232, 19233, 19239, 19240

18973 (CONF-781235—P1, pp 15-17) **Materials selection and energy conservation.** Evans, R.D. (Florida Technological Univ., Orlando). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18974 (CONF-781235—P1, pp 23) **Performance of a dual alternating evaporator heat pump for a hybrid annal cycle energy system.** Somerville, M.H.; Albrecht, L. (Univ. of North Dakota, Grand Forks). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18975 (CONF-781235—P1, pp 101-104) **Effect of variable ventilation timing on the estimated temperature of an enclosure.** Hanna, G.B. (Univ. of Riyadh, Saudi Arabia). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18976 (CONF-781235—P1, pp 139) **Evaporative cooling: today's viable alternative.** Barton, G.S. 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18977 (CONF-781235—P1, pp 283-285) **New building energy conservation standards and solar energy utilization: trade-offs and optimal systems.** Kah, G.F. (Donovan, Hamester and Rattien, Inc., Washington, DC). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18978 (CONF-7805138—P2) **Earth-covered buildings and settlements.** Moreland, F.L. (ed.). (Texas Univ., Arlington (USA)). 1978. Contract W-7405-ENG-26. 370p. Dep. NTIS, PC A16/MF A01.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

Opening remarks were made by Wilbur T. Coyle, Program Manager in the Buildings and Community Systems Division, Department of Energy, wherein he discussed briefly DOE's plans for innovative shelter for energy conservation as well as the role of his Division. A separate abstract was prepared for each of the 26 presentations in this volume; all abstracts will appear in both Energy Research Abstracts (ERA) and Energy Abstracts for Policy Analysis (EAPA).

18979 (EPRI-EM—1261) **State-of-the-art assessment of hybrid heat pumps. Final report.** Blatt, M.H.; Erickson, R.C. (Science Applications, Inc., La Jolla, CA (USA)). Dec 1979. 171p. Dep. NTIS, PC A08/MF A01.

The role of the hybrid heat pump is evaluated and is compared with other HVAC system options. A hybrid heat pump is an HVAC system which includes an electrically driven heat pump and supplementally fired gas or oil boiler. This system was compared with heat pumps, oil-fired boilers, and gas-fired boilers for various regions of the US.

18980 (LA-UR—80-848) **How can energy-efficient structures compete in an inefficient energy market.** Noll, S. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 11p. (CONF-800429—1). Dep. NTIS, PC A02/MF A01.

From Institute of Gas Technology conference on future alternatives in residential and commercial space conditioning; Chicago, IL, USA (14 Apr 1980).

The only way resources can be efficiently allocated in our market system is if prices of resources, goods, and services properly reflect their true value to society. However, because of (a) imperfections in the pricing mechanisms that currently influence private-sector decision making; (b) the difference in planning horizons between individuals and government; and (c) the external benefits that would accrue to society from energy-conscious decision making by individuals, it is apparent that there exists a substantial underinvestment in advanced-conservation and renewable-resource building technologies. Even if domestic energy prices were deregulated to reflect world market prices (now determined by OPEC) it is likely that underinvestment in energy-conscious design would still occur. For that reason, the only way that energy-conscious design will be implemented to the extent warranted is if a concerted political commitment is made to such a program at the Federal, state, and local levels. Such a commitment is not without precedent. The experiences of Davis and San Diego, California, and the TVA exemplify the extent to which energy conservation and renewable-resource development can be carried out if political leadership and support is established. It is known that technologies and design solutions for energy-efficient buildings are available today and are cost-effective. What remains to be seen is whether the political leadership of the United States will fully recognize the sensibility of a concerted conservation and renewable-energy-resource program for buildings as opposed to continued attempts at increasing energy production to supply an energy-inefficient-building inventory. 16 references.

18981 (LBL—9578) **Ventilation and odor control: prospects for energy efficiency. Final report of Phase I.** Cain, W.S.; Berglund, L.G.; Duffee, R.A.; Turk, A. (John B. Pierce Foundation Lab., New Haven, CT (USA); TRC Environmental Consultants, Weathersfield, CT (USA); City Univ. of New York, NY (USA)). Nov 1979. Contract W-7405-ENG-48. 67p Dep. NTIS, PC A04/MF A01.

The various factors that play a role in the determination of ventilation requirements for odor control are described. Studies that uncovered and quantified the connection between odors and ventilation systems requirements are reviewed. They were usually motivated by interest in public hygiene and health. Recent discoveries regarding excessive levels of formaldehyde in buildings lined with chipboard, excessive levels of particulate matter in the vicinity of smokers, and excessive levels of oxides of nitrogen in homes with gas stoves, have, in conjunction with the need for energy efficiency, refocused attention on the origin and adequacy of nonindustrial ventilation rates. Subsequent to a review of the research basis for modern ventilation rates, the varieties of odor control applicable indoors are examined. The section on control deals at length with chemical and engineering considerations in the use of granular filter media, the most practical means of indoor odor control. A chapter on odor perception focuses on sensory phenomena, followed by a chapter on both chemical and psychophysical methodology. Prospects are discussed in the final chapter. (MCW)

18982 (SIB-R—95-1979) **Waste water heat recovery.** Hedlund, A.; Litzberg, L. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1979. 45p. (In Swedish). Dep. NTIS (US Sales Only), PC A03/MF A01.

A heat exchanger for waste water heat recovery was designed and tested as a water preheater and a heat pump evaporator. Continuous mechanical cleaning of the heat transfer surfaces was used.

18983 (STU—77-3522) **Chemical heat pump: a study of open systems.** Bjurstroem, H.; Eriksson, J.C.; Loefvenberg, A.; Wettermark, G. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden)). Oct 1979. 86p. (In Swedish). Dep. NTIS (US Sales Only), PC A05/MF A01.

A system open to the atmosphere was studied, which uses the water vapor of the air as a heat source. To reduce frost problems, the heat is not extracted in a condenser, but rather through sorption on a suitable sorbent such as a salt hydrate or a zeolite. This air-drying unit is used as a first stage for a conventional heat pump.

18984 (LIB-tr—4897) **Heat pump: general aspects, saving in energy, purchase costs.** van der Ree, H. Translated from *Gas (The Hague);* **99**: No. 3, 113-120(Mar 1979). 21p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Some general information is provided about the development and characteristics of heat pumps, about the achievable economies in primary energy, as well as about the present level of acquisition costs of heat pump aggregates and systems. A difference is made between two categories of heat pumps, i.e., the electromechanical pumps and the installations which are driven directly by thermal energy. Especially in the latter category, large energy savings can be achieved for heating purposes. Owing to the available infrastructure for natural gas in a relatively mild sea climate, the thermally-driven heat pump provides good conditions especially for Holland.

RESIDENTIAL BUILDINGS

REFER ALSO TO CITATION(S) 18659, 18708, 18801, 18940, 18944, 18945, 18946, 18948, 18949, 18952, 18953, 18958, 18966, 19234, 19235, 19236, 19237, 19238

18985 (CONF-781235—P1, pp 287) **Minimum energy dwelling: a practical approach to energy conservation.** Ashworth, R.A. (Southern California Gas Co., Los Angeles). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18986 (CONF-781235—P1, pp 301-302) **Design of a low cost microcomputer total energy control system for small buildings.** Colvin, T.D.; Murray, T.M. Jr. (Univ. of Louisville, KY). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18987 (CONF-781235—P1, pp 305) **Developing energy conservative single family housing for the Air Force.** Robbins, C.L. (Florida A and M Univ., Tallahassee). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18988 (CONF-781235—P1, pp 309-310) **Low cost microcomputer energy control and monitoring system for small buildings.** Lea, J.R.; Spencer, C.H.; Murray, T.M. Jr. (Univ. of Louisville, KY). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

18989 (CONF-7805138—P2, pp 44-53) **Integrating earth-covered housing into existing energy-efficiency codes structures.** Higgs, F.S. (Louisiana State Univ., Baton Rouge). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

Earth-covered construction is making its debut into the American building inventory at a time when the introduction of non-typical approaches to building is extremely difficult. While the emerging building codes aimed at energy efficiency in buildings specify energy consumption per unit of floor area for specific generic types of construction, these codes are only as flexible as the mechanisms specified for design evaluation. These mechanisms, whether automated, prescriptive, or hand-calculation-oriented are designed around conventional construction practice and give little, if any, response to such atypical approaches as passive systems or earth-covered construction. Exploring the problems associated with leading the development of thermal models for high mass construction from its present state to a form readily usable within existing state building codes, the author notes areas for their immediate use. 7 references.

18990 (CONF-7805138—P2, pp 256-266) **Underground dwellings built in Oklahoma.** Kneeland, W.F. 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

Moderate soil temperatures provide an opportunity to dramatically reduce the total heating and cooling energy requirements of a residence. Many such underground houses are currently demonstrating to designers a number of possible efficient configurations and energy systems. A number of references are used to demonstrate the thermal benefits of underground dwellings. The content of the material and engineering observations, both academic and as built, indicates that energy performance based upon the thermal regime in which the house is constructed is beneficial in reducing energy consumption. The placement of the dwelling in the ground and the location of the insulation is necessary for good performance. Minimum exterior exposed walls improve energy performance. When constructed in conjunction with existing design technology and well-behaved heat-transfer engineering, the moderate variations between indoor and outside earth temperatures can be expected to reduce energy consumption and at the same time offer a well-built house. 8 references, 2 figures.

18991 (CONF-7805138—P2, pp 267-272) **Underground house in South Dakota.** Feisel, L.D. (South Dakota School of Mines and Tech., Rapid City). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

The site-planning, construction details, and a two-year performance record are reported for an owner-designed underground house in South Dakota. Site preparation in a small ravine required plans for de-watering a natural drainage area. The house is cut into a canyon wall to maximize the view. Electric baseboard heaters offer individual room control and are backed by two fireplaces. There is maximum use of natural light and ventilation. Energy savings have been accomplished, although monitoring of the thermistors has been irregular. The owners report satisfaction with comfort and a feeling of isolation from street noise and weather. (DCK)

18992 (CONF-7805138—P2, pp 273-277) **Ashford earth-covered residence: Muleshoe, Texas.** Kiesling, E.W.; Boubel, G.A. (Texas Tech. Univ., Lubbock). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

The structural design planning and construction of an earth-covered home in Texas are described. The goal of the owner and the planners is to develop a low-cost house using the most appropriate construction techniques for the area. Several design concepts, such as the use of earth forms for the concrete shell, and modifications of standard construction methods are summarized. Because many of the features have no counterpart in standard construction, cost comparisons with conventional housing are difficult. The initial construction costs have been somewhat higher than an above-grade house of the same size, but long-term operating costs are expected to be lower. 2 figures. (DCK)

18993 (COO—4559-1) **Design, construction and performance of stick-wood fired furnace for residential and small commercial application, September 1, 1977-August 31, 1979.** Hill, R.C. (Maine Univ., Orono (USA)). Oct 1979. Contract EC-77-S-02-4559. 28p. Dep. NTIS, PC A03/MF A01.

An experimental program was conducted at the University of Maine at Orono to develop a combustion system for residential furnaces that solves the traditional problem of wood burning: inefficiency, air pollution, and fire hazard. The program led to the designs that are now covered by a patent application and are being manufactured by Dumont Industries, Madawaska Wood Furnace Company, and Hampton Technologies Corporation Ltd. The history, design, performance, and the construction of prototype production units are presented.

18994 (HNEI—80-01) **Heat recovered from domestic refrigerator for water heating. Final project report.** Chou, J.C.S. (Hawaii Univ., Manoa (USA). Hawaii Natural Energy Inst.). Dec 1979. Contract EM-78-G-03-1938. 67p. Dep. NTIS, PC A04/MF A01.

The concept of adding a water-cooled condenser to household refrigerator for preheating domestic hot water was tested in laboratory by installing a 2 1/2-in.-diameter by 11 in.-length water-cooled condenser in a 16-ft^3 top-freezer refrigerator. The condensing vapor may be directed through either the water-cooled condenser or the existing air-cooled condenser. At the normal operation, the useful heat gain of warm water in a 30-gallon storage with 1.9 in. thick fibrous glass wool insulation was about 2 kWh. Heat balance indicated that the energy recovery can be much higher if a water-cooled compressor can be incorporated into the system. For the popular 16-ft^3 top-freezer baseline model, it is possible to recover 3.5 kWh per day with water-cooled condenser, water-cooled compressor, and well-insulated storage tank. Because of the difficulty of having a simple design of the heat-recovery device for various models of refrigerators, besides the high labor cost of inserting the device into an existing system, modification of any existing household refrigerator with the water-cooled condenser as described in

this report is not recommended. However, if such a device can be provided as an optional accessory of a new refrigerator, the system could be economically attractive to homeowners.

18995 (ORNL/Sub—79/13660/1) **Minnesota Retrofit Insulation In-Situ Test Program: extension and review.** (Weidt (John) Associates, Inc., Minneapolis, MN (USA)). Feb 1980. Contract W-7405-ENG-26. 40p. Dep. NTIS, PC A03/MF A01.

An insulation's performance is of primary concern to the consumer who is considering re-insulating his home. Minnesota Retrofit Insulation In Situ Test Program, published by the Department of Energy in June 1978, details the findings of an in situ study of various thermal insulations installed in 55 residences in the Minneapolis/St. Paul area. The study, conducted in the summer of 1977, consisted of field observations and laboratory measurements of properties critical to the insulations' performance. Properties studied included density, thermal resistance, moisture content, shrinkage, flammability, friability, and compression strength. This study, Phase I, was extended with a second phase to include further in-situ study of retrofit insulations. Included in this extension work, Phase II, was a further study of the moisture content of insulations, the corrosiveness of retrofit loose-fill cellulose insulation, thermography and field observations of sidewalls for signs of settling of retrofit loose-fill insulations, analysis of fuel consumption data for a number of the retrofitted homes, and density and thermal resistance retests of loose-fill insulations. This report details the field and laboratory findings of Phase II.

18996 (SIB-G—9-1979) **Taeby project: co-ordinated research on energy-saving single-family houses.** Lindskoug, N.E. (Swedish Council for Building Research, Stockholm). 1979. 28p. (In Swedish). Dep. NTIS (US Sales Only), PC A03/MF A01.

A research project on energy savings in single family houses is presented. Six groups of houses, with four houses in each group, have been equipped with different combinations of energy saving systems, including solar energy collectors, heat recovery for ventilation air, heat pumps, and control systems.

18997 (SIB-R—55-1979) **Pilot studies of space heating using earth heat pumps: geological factors.** Modin, B. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1979. 84p. (In Swedish). Dep. NTIS (US Sales Only), PC A05/MF A01.

A review is presented of the geologic and hydrogeologic problems that can be encountered in the planning of systems for earth heat pumps and energy storage in the ground.

18998 (SIB-R—75-1979) **Air-to-air heat pumps in one-family houses: a field study at Viksjoe, Jaerfaella, Sweden.** Andersson, K.A.; Pettersson, U. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1979. 108p. (In Swedish). Dep. NTIS (US Sales Only), PC A06/MF A01.

Measurements of energy consumption, temperatures, etc. in 3 groups of identical houses (31 houses in all) are reported. One group of houses was equipped with normal electric radiators, another with electrically-heated air-ventilation systems, and the third with air-to-air heat pumps. It is concluded that the hot-air systems requires about 20% more energy than the radiator system. The energy saved by using the heat pumps was about 12% and does not make the extra investment profitable.

18999 (SIB-R—90-1979) **Heat pump installation in a small house with oil furnace and water radiators: air-water system.** Groendalen, O. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1979. 48p. (In Swedish). Dep. NTIS (US Sales Only), PC A03/MF A01.

Operation results are described for an air-to-water heat pump installed in a one-family house in Southern Sweden, covering the period September 1976-December 1977. The heat pump and heat accumulator were connected to an already existing radiator system.

19000 (STU—75-3236) **STR: low-energy project for one-family houses Vetlanda, Sweden, 1977-79.** Jonsson, B. (Tekniska Hoegskolan, Lund (Sweden). Inst. foer Byggnadskonstruktionslaera). Sep 1979. 177p. (In Swedish). (BKL—1979-11). Dep. NTIS (US Sales Only), PC A09/MF A01.

The report describes low-energy houses built with ordinary components and well-known techniques. The heat losses are limited by good insulation and air-tight construction. The energy savings amounted to about 30% of the consumption of a similar reference house with standard construction.

OFFICE BUILDINGS

19001 (CONF-781235—P1, pp 97-100) **Energy conservation system application with solar assisted heat pump in a large building in Spain.** Mattalon, R.W. (Westinghouse Electric Europe S.A., Brussels, Belgium); Goujon, J. 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

19002 (CONF-7805138—P2, pp 241-255) **Underground California office building wins national energy design competition.** Boyer, L.L. (Benham Blair and Affiliates, Oklahoma City, OK). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

The award-winning design of a California state office building combines the innovative use of underground space, natural lighting and ventilation, solar-assisted temperature control, and other techniques to produce one of the most energy-efficient public buildings to date. The thermal efficiency is rated at 1.004 and annual energy consumption at 19.88 Btu/sq ft/year, which is only 29% of the standard adopted by the American Society of Heating, Refrigerating, and Air Conditioning Engineers in 1975. A minicomputer system controls the building's use of equipment to take advantage of natural energy sources and stored and recycled energy. 3 references, 1 table.

19003 (COO—2799-T6) **Energy conservation in existing office buildings. Phase 1. Executive summary.** (Syska and Hennessy, New York (USA); Tishman Research Corp., New York (USA)). 1979. Contract EY-76-C-02-2799. 56p. Dep. NTIS, PC A04/MF A01.

The potential value of various retrofitting or procedural conservation measures in existing office buildings, beyond those achieved voluntarily in 1974 and 1975, was established and strategies for translation in practical and workable industry-wide applications and standards are recommended. The research is based on an examination of more than 1000 office buildings containing about 250 million square feet of gross space in New York City. A summary of Phase I (Phase I of III) is presented and consists of classification of the office building inventory in New York City; selection of a representative sample and development of the methodology for such; obtaining pertinent data on energy consumption (before and after the 1973 oil embargo) including the development of a normalization procedure for comparative analysis; gathering physical and operating characteristics of buildings; and analyzing some of the interrelationships between these characteristics and energy consumption.

19004 (LBL—9960) **Energy efficiency and performance of solid state ballasts.** Jewell, J.E.; Selkowitz, S.; Verderber, R. (Pacific Gas and Electric Co., San Francisco, CA (USA); California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 41p. (EEB-L—79-07; CONF-7908111—1). Dep. NTIS, PC A03/MF A01.

From 19. international commission on illumination session; Kyoto, Japan (21 Aug 1979).

A project was undertaken to test the energy efficiency of ballasts. Two ballast types were used and retrofitted into existing fixtures on 3 floors in an office building in San Francisco. A core-coil energy efficient ballast was demonstrated also. The demonstration ballasts proved to be more efficient than the standard core-coil ballasts they replaced. Their energy demand reduction has resulted in a lower weekly peak demand. Operating above 20 KHz they have produced less audible noise. They also have lower heat dissipation. RFI radiation, although increased, has caused no apparent difficulties. Light output has been reduced slightly by all three demonstration ballasts. Ballast energy usage has been measured successfully with standard utility metering but there remain doubts as to the effects of the harmonics associated with solid-state circuitry. While no adverse effects have been observed, research must continue on the accuracy of electrical metering and on the effect on utility systems. The demonstration project has shown that solid-state fluorescent ballasts providing high frequency operation can be installed successfully in large numbers without adverse effects and with substantial energy saving.

SCHOOL, MUNICIPAL AND OTHER PUBLIC BUILDINGS

REFER ALSO TO CITATION(S) 18957

19005 (CONF-781235—P1, pp 19-21) **Energy saving modes of operation for a reheat air conditioning system.** Lanz, R.W. (Univ. of Wisconsin, Green Bay). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

19006 (CONF-781235—P1, pp 69-70) **Some barriers to commercialized use of energy conservation technologies in West Virginia public schools.** Steinhardt, E.J. (West Virginia Univ., Morgantown); Gochenour, D.L. Jr.; Machesney, J.D. 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

19007 (MLM-MU—80-62-0001) **Proceedings: utilities operations seminar.** (Mound Facility, Miamisburg, OH (USA)). 1979. Contract EY-76-C-04-0053. 52p. Dep. NTIS, PC A04/MF A01.

The proceedings of the Utilities Operations Seminar are given and the papers presented are noted. Titles of presentations are

Facilities Management Branch; Fuel Policy, and the Alternate Energy Source Program; Operators Selection and Training; Utilities Systems at Mound; Water Treatment and Waste Water Treatment; Utilities Operator Classification; Operator Training; Utilities Monitoring System; Reverse Osmosis System; Waste Water Management; and Environmental Program. Many visual aids are included for the paper presentations.

19008 (PB—80-106610) **Energy conservation measures for the Charles E. Shea Senior High School, Pawtucket, Rhode Island. Public service report.** (New England Innovation Group, Providence, RI (USA)). Jul 1979. 36p. NTIS, PC A03/MF A01.

A thermographic audit of a Pawtucket, Rhode Island high school is reported. Conducted with the aid of an infrared camera system, this thermographic study located heat losses not evident to the naked eye. Heat losses were documented and the thermograms analyzed to obtain complete knowledge of the location of all heat losses from the building complex. Each thermogram showed one or more types of heat loss together with the specific section of the building where it occurred. Priorities were assigned to various retrofit processes and a thermographic inspection conducted after retrofitting to confirm its efficacy. The study comprised an analysis and recommendations of heat loss and heating system appraisals plus an analysis of roof moisture inspection. Numerous thermograms illustrate the report.

19009 **Public care buildings can save energy dollars.** Albany, NY; New York State Energy Office (1979). 121p. (NP—24354).

Information is presented on energy conservation, program requirements, operation and maintenance procedures, instructions, and forms for completing energy audits in health care facilities. The energy audit will establish a profile of each facility with respect to type, size, energy use level, and energy using systems; identify changes in operations and maintenance procedures that would reduce energy consumption without significant capital expenditure; and indicate the need for energy conservation measures requiring capital expenditures.

19010 **Local government buildings can save energy dollars.** Albany, NY; New York State Energy Office (1979). 131p. (NP—24355).

Requirements, procedures, instruction, and forms for completing energy audits in local goernment buildings, including qualifications for energy auditors, are presented. The energy audit includes the Preliminary Energy Audits plus an assessment of operational and maintenance procedures and capital cost energy conservation measures.

19011 **Schools can save energy dollars.** Albany, NY; New York State Energy Office (1979). 236p. (NP—24363).

The workbook presents information to help perform an energy audit for schools, specifically for private schools, kindergarten to 12th grades. It also presents information to assess the facilities and to determine the various opportunities that exist for energy conservation in the following six sections: Operational and Maintenance Table; Energy Measures Cost and Payback Table; Matrix of Space Function vs System Function; Energy Survey Worksheets; Energy Measures; and Energy Audit Forms.

19012 **Hospitals can save energy dollars.** Albany, NY; New York State Energy Office (1979). 120p. (NP—24365).

Measures on how to implement an energy conservation program using skills and resources already on hand and measures requiring significant capital investment are presented. Implementation of the measures outlined can result in a 5 to 15% savings on the hospital energy bill. The energy management and administrative aspects of the program suggest ways of implementing energy consciousness and maximum participation. Calculation methods and procedures are presented for estimating energy and dollar savings. Assistance necessary to conduct an energy audit and how to obtain the data required for federal reporting are included. An analysis and computations following the walk-through audit must be reported to th NYSEO and these instructions are presented in the appendix.

COMMERCIAL AND INDUSTRIAL BUILDINGS

REFER ALSO TO CITATION(S) 18993

19013 (CONF-781235—P1, pp 289-290) **Evaluation of retrofitted commercial window insulation systems.** Tsui, R.K. (Northeastern Univ., Boston, MA); Garcia, L.M. 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

TRANSPORTATION

AIR AND AEROSPACE

19014 (AD-A—068449) **Goodyear aerospace conceptual design maritime patrol airship ZP3G. Final report.** Brown, N.D. (Goodyear Aerospace Corp., Akron, OH (USA)). 1 Apr 1979. Contract N62269-78-M-4580. 71p. NTIS, PC A04/MF A01.

A Conceptual design of a modern technology airship with precision hover capability for use in maritime patrol is described. The size and major characteristics are established by a series of United States Coast Guard missions set forth by the contracting agency.

RAILWAY

19015 (DOE/EV—0070) **Technology assessment of productive conservation in urban transportation. Project description for fiscal years 1980, 1981.** (Department of Energy, Washington, DC (USA). Div. of Technology Assessments). Dec 1979. 32p. Dep. NTIS, PC A03/MF A01.

An investigation of the potential environmental, health, and safety impacts of various alternative productive conservation strategies is presented. The technology assessment identifies internally consistent (mutually reinforcing policy or technology elements following a specific theme) productive conservation strategies which will aid in the reduction of the US dependence on petroleum in urban transportation; compares analytically the energy savings and environmental impacts of the various productive conservation strategies; and analyzes the issues and the barriers which may constrain these productive conservation strategies from becoming effective. Each strategy is discussed. Major tasks that occur during 4 phases are discussed, e.g., data collection, model assembly, impact criteria; in-place policy analysis; analysis of alternative strategies; and documentation.

19016 (PB—296392) **A multipurpose train performance calculator: volume I - users' manual. Final report.** Heilman, H.; Kahrs, C.; Williams, G. (Union Coll., Schenectady, NY (USA). Dept. of Electrical Engineering and Computer Science). Dec 1978. Contract DOT-FR-8027. 81p. NTIS, PC A05/MF A01.

This manual documents a train performance calculator (TPC) program which simulates the operation of a passenger train over a rail route. The input for the program is the track data for the route, the characteristics of the locomotive, the type and number of cars, and the number of passengers. The output from the TPC is in the form of tables showing speed, time, and fuel used; and in the form of graphs showing speed, time, and fuel used versus distance traveled. The TPC has been in use for two years to study the energy intensity of AMTRAK trains in the New York to Buffalo corridor.

19017 (PB—296393) **A multipurpose train performance calculator: volume II - programmers' reference manual. Final report.** Heilman, H.; Kahrs, C.; Williams, G. (Union Coll., Schenectady, NY (USA). Dept. of Electrical Engineering and Computer Science). Dec 1978. Contract DOT-FR-8027. 84p. NTIS, PC A05/MF A01.

This manual documents a train performance calculator (TPC) program which simulates the operation of a passenger train over a rail route. The input for the program is the track data for the route, the characteristics of the locomotive, the type and number of cars, and the number of passengers. The output from the TPC is in the form of tables showing speed, time and fuel used; and in the form of graphs showing speed, time, and fuel used versus distance traveled. The TPC has been in use for two years to study the energy intensity of AMTRAK trains in the New York to Buffalo corridor.

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 19015, 19101, 19102, 19103, 19104, 19105, 19106, 19107, 19108, 19109, 19110, 19111, 19112, 19113, 19114, 19115, 19116, 19117, 19118, 19119, 19120, 19121, 19122, 19123, 19124, 19125, 19126

19018 (PB—296495) **Evaluating options in statewide transportation planning/programming - techniques and applications. Final report.** Bellomo, S.J.; Mehra, J.J.; Stowers, J.R.; Cohen, H.S.; Sinnott, J.H. (Voorhees (Alan M.) and Associates, Inc., McLean, VA (USA). Planning Environmental International Div.; System Design Concepts, Inc., Washington, DC (USA); American Association of State Highway and Transportation Officials, Washington, DC). Mar 1979. 202p. NTIS, PC A10/MF A01.

Four planning techniques are presented, each dealing with a current problem facing state agencies. Forecasting highway user revenues, determining the effect of alternative levels of bond financing, selecting projects for inclusion in a construction program based on an objective evaluation, and measuring energy impacts of various transportation alternatives are addressed. The four techniques include: (1) Highway User Revenue Model (HURM), (2) Short-Range

Capital Resource Availability Model (SCRAM), Priority Programming System (PPS), and (4) Energy Impacts of Transportation Actions (EITA). Each technique was tested in a state transportation agency to determine the amount of time and effort required for implementation. A companion document, NCHRP Report 179, contains the findings of the first phase of this research and provides a comprehensive analysis of statewide planning issues, data requirements, and analysis techniques.

19019 (PB—80-105802) **Power requirements of articulated vehicles under cornering conditions.** Gyenes, L.; Williams, T.; Simmons, I.C.P. (Transport and Road Research Lab., Crowthorne (UK)). [nd]. 23p. NTIS, PC A02/MF A01.

Experimental and theoretical investigations have shown that to overcome the forces induced as a vehicle turns a sharp corner the power output from the engine must be increased considerably. Steady state power when cornering can be predicted by a simple summation of the work done by the tractive effort in overcoming the rolling resistance, the centrifugal forces and the bogie slewing moments at each group of axles. Fixed axles with no articulation are the prime cause of the increase in power. Slip angles were calculated and tire wear assessed at the various axles of an articulated vehicle. For long haul operation the effect of cornering will not account for more than about 3 per cent of the total fuel consumption.

INDUSTRY AND AGRICULTURE

REFER ALSO TO CITATION(S) 19088

ENERGY SOURCES

REFER ALSO TO CITATION(S) 18349, 18934, 19244

MATERIALS

19020 (COO—4269-T1) **Phase I: energy-conservation potential of Portland cement particle-size-distribution control. Final report, March 1979.** (Portland Cement Association, Skokie, IL (USA). Construction Technology Labs.). Mar 1979. Contract EC-77-C-02-4269. 107p. Dep. NTIS, PC A06/MF A01.

The properties of cements with carefully controlled particle-size distributions were compared with those of normally ground cements having a Blaine fineness of about 3600 cm^2/g. Progressive reduction of the maximum particle size to 20 microns improved strength development. Further reduction to about 14 microns decreased rather than improved strength development. Some of these particle-size-controlled cements produce as-high, and often much-higher, strengths at ages from 1 to 60 days at Blaine finenesses 450 to 800 cm^2/g lower than the normal grinds of the same composition. The cements with 20-micron maximum-size particles can have finenesses as low as 2800 cm^2/g, whereas with larger particles, higher specific-surface areas are required for equal strengths. The improved strengths were a result of more-rapid and more-complete hydration of the cement. Variations of clinker composition did not significantly alter these conclusions. Drying shrinkage of the particle-size-controlled cements was in some cases less than for normally ground cements. They also performed better than normally ground cements over a wide range of mixing and curing temperature (42°F to 100°F). Direct energy conservation of 27% in finish grinding and 8.5% in more-efficient utilization of the cement is estimated to result from the use of particle-size-controlled cements. For a US production of 75 million tons, this corresponds to conservation of 46.5 trillion Btu/year.

19021 (DOE/R5/10121—1) **Insulation from basaltic stamp sand. Semi-annual technical progress report.** Williams, F.D. (Michigan Technological Univ., Houghton (USA). Dept. of Chemistry and Chemical Engineering). 1980. Contract FG02-79R510121. 10p. Dep. NTIS, PC A02/MF A01.

Stamp sand dumps from the mining of copper are identified. The chemical composition of the Keweenau and Russian basalts and 2 commercial glasses is given. Temperature-viscosity relationships for the production of high quality basaltic fibers are discussed. A preliminary rough fiber test is described. Fibers made from sands from Point Mills spit 4 using a drawing technique to produce textile grade fibers and using a blowing technique to produce a fiber mat are described. Fiber mats will be evaluated as thermal insulators. (DC)

EQUIPMENT AND PROCESSES

REFER ALSO TO CITATION(S) 18386, 19217

19022 (ANL/OEPM—79-4) **Survey of potential processes for the manufacture of aluminium.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Dec 1979. Contract W-31-109-ENG-38. 84p. Dep. NTIS, PC A05/MF A01.

The following alternative processes to the Hall-Heroult cell for the production of primary aluminum - direct carbothermic reduction of alumina are considered; reduction of bauxite to an aluminum-silicon alloy; the subchloride process; the disproportionation of aluminum sulphide; the production through a nitride intermediate; and electrolysis of aluminum chloride, aluminum sulphide and aluminum nitride; and plating from non aqueous solvents. Comparisons of energy consumption are made with current Hall-Heroult technology and with projected improved technology - particularly titanium diboride cathodes and permanent anodes. The major conclusion is that the only alternative technology at present is the Alcoa chloride electrolysis process but that sulphide and nitride electrolytic processes offer potential advantages in the future. With the exception of thermal reduction to an aluminum - silicon alloy none of the carbothermic processes is competitive because they require electric furnaces. Significant improvements in energy consumption could be achieved with titanium diboride cathodes in the Hall-Heroult cell though a long lived cathode has yet to be demonstrated.

19023 (COO—4527-4) **Application of foams to the processing of fabrics. Final report, October 1, 1977-September 30, 1979.** Duke, M.W. (United Merchants Research Center, Langley, SC (USA)). Dec 1979. Contract EC-77-C-02-4527. 52p. Dep. NTIS, PC A04/MF A01.

In mill trials, a range of foam fabric finishes including softeners, hand builders, and durable-press and shrink-resistant types were applied to cotton sheeting, corduroy, and polyester/cellulosic blends, etc. In all cases, substantial energy savings were realized. A number of companies are currently using foam fabric finishing as a commercial production process. Additionally, the pilot range has been used to demonstrate foam fabric finishing to over twenty companies. The range has been used to demonstrate the foam acid dyeing of nylon carpets to several companies in this specialized area of textile processing. Active work still continues with these companies since the foam dyeing of carpets involves only about 1/5 the water used in the normal continuous dyeing of carpets. Energy conservation is realized both from reduced steam consumption in steaming colors and less heat used for drying.

19024 (DOE/CS/40061—6) **Use of precalciners to remove alkali from raw materials in the cement industry. Quarterly technical progress report, November 1979-January 1980.** Gartner, E.M. (Portland Cement Association, Skokie, IL (USA). Construction Technology Labs.). Mar 1980. Contract EM-78-C-02-4929. 21p. Dep. NTIS, PC A02/MF A01.

Experiments using the sulfate fusion technique have continued. High degrees of alkali removal have been achieved using $CaSO_4$ admixtures with added $CaCl_2$ and $Mg(NO_3)_2$. The presence of Mg^{2+} or Cl^- in the mixtures did not affect the phase separation significantly. There was considerable evidence for preferential migration of K^+ into the sulfate phase, relative to Na^+. A new technique, the powder drop method, was used to attempt to more closely simulate the alkali removal reactions which would occur in a reactor. Rapid removal of K^+ from most minerals was shown to occur with a sulfate melt initially containing 20% Na_2SO_4 and 80% $CaSO_4$. However, in most cases, the Na^+ content of the slag layer actually increased.

19025 (DOE/CS/40208—T1) **Evaporation by mechanical vapor recompression. Technical progress report, September 1-December 31, 1979.** Iverson, C.H.; Coury, G.E. (Beet Sugar Development Foundation, Fort Collins, CO (USA)). 1979. Contract AC03-79CS40208. 26p. Dep. NTIS, PC A03/MF A01.

Progress to date in the development of a study of the application of the technologies of mechanical vapor recompression and falling film evaporators as applied to the beet sugar industry is reported. Progress is reported in the following areas: technical literature search and plant visitations of existing applications of VR/FFE.

19026 (EUR—6679) **Energy savings in paper making by means of increased water removal in the press-section. Final report.** Westra, H.A. (Nijverheidsorganisatie TNO, Delft (Netherlands). Fibre Research Inst.). 1980. 29p. Dep. NTIS (US Sales Only), PC A03/MF A01.

Research on the pressing process in the manufacture of paper and board in order to decrease the amount of water that has to be removed by means of evaporation, which is a much more energy consuming process, is described. The first phase of the project was comprised of a theoretical analysis of the processes taking place in a press and development of an experimental technique for determination of the material properties which exert an influence upon these processes.

19027 (STU—79-3197) **Alternative fuels for furnaces used for metallurgic processes.** Bothvidson, A. (Styrelsen foer Teknisk Ut-

veckling, Stockholm (Sweden)). May 1979. 24p. (In Swedish). Dep. NTIS (US Sales Only), PC A02/MF A01.

It was concluded from interviews with people from the metal industry, process designers, and branch organizations that oil corresponding to a yearly consumption of 400,000 m^3 could be replaced with coal without important reconstructions of the furnaces. A coal slurry containing coal, water, and oil could be used directly as fuel, or a gas could be produced from the slurry.

WASTE HEAT RECOVERY AND UTILIZATION

REFER ALSO TO CITATION(S) 18982

19028 (CONF-781235—P1, pp 291-293) **Analysis of the institutional constraints for implementing industrial cogeneration in California.** Edelson, E. (Jet Propulsion Lab., Pasadena, CA). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

19029 (DOE/CS/40012—1) **High temperature range recuperator. Phase I: materials selection, design optimization, evaluation and thermal testing. Final report, April 1977-May 1978.** Power, D.V. (Terra Tek, Inc., Salt Lake City, UT (USA)). Jun 1978. Contract EY-77-C-07-1660. 113p. Dep. NTIS, PC A06/MF A01.

Initial efforts to develop, test, and evaluate counterflow recuperator designs are reported for the High Temperature Range Recuperator project. Potential materials to withstand glass furnace exhaust environments at temperatures up to 2800°F were evaluated on the bases of material properties, fabrication capability, and relative performance in the flue environment of a day tank glass furnace. Polycrystalline alumina (Vistal), reaction sintered silicon carbide (KT and NC 430), chemically vapor deposited silicon carbide (CVD) and sintered alpha silicon carbide proved most satisfactory in the material temperature range of 2300°F to 2800°F. Relatively pure alumina (AD 998 and AD 94), mullite and cordierite were most satisfactory in the material temperature range of 1700°F to 2300°F. Recuperator designs were evaluated on the bases of cold air flow tests on laboratory models, fabricability, and calculated thermomechanical stress under expected operating conditions. Material strengths are shown to be greater than expected stresses by factors ranging from 2.6 for KT silicon carbide to 16 for cordierite. Recuperator test sections were fabricated from KT silicon carbide and subjected to thermal stress conditions in excess of twice the expected operating conditions with no deterioration or failure evident. A test section was subjected to the thermal shock of instant transfer between room temperature and a 2000°F furnace without damage. Economic analysis based on calculated heat transfer indicates a recuperator system of this design and using currently available materials would have a payback period of 2.3 years.

19030 (NE-PROJ—2060591(Pt.1)) **Heat storage in ground water. Part 1. Study of ground water reservoirs.** (Vattenbyggnadsbyraan, Stockholm (Sweden)). Jan 1980. 91p. (In Swedish). Dep. NTIS (US Sales Only), PC A05/MF A01.

The possibilities to use industrial waste heat, available during the summer season, for space heating in Klippan, southern Sweden were examined, in particular, a project including seasonal heat storage in a ground-water reservoir. It was determined that 6 to 7 GWh could be stored at a water temperature of 15 to 30°C. Hydraulic and thermal measurements of reservoirs are reported. Systems for distribution of low-temperature heat are discussed. Further field measurements are necessary before any decisions are made.

19031 (NE-PROJ—2060591(Pt.2)) **Heat storage in ground water. Part 2. Study of distribution systems.** (Vattenbyggnadsbyraan, Stockholm (Sweden)). Jan 1980. 51p. (In Swedish). Dep. NTIS (US Sales Only), PC A04/MF A01.

Suggestions are made for design of a district-heating system in a small town in southern Sweden. Waste heat produced during summertime in a local industry can be seasonally stored in a ground water aquifer, and used as a source for heat pumps in wintertime. This report discusses the total economy of the project and makes comparisons with more-conventional systems.

19032 (SIB-R—109-1979) **Heat from cooling forgings: follow-up of an installing in the forge at Oeverums Bruk, Sweden.** Odhe, B.; Sandstedt, A.; Strindehag, O. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1979. 24p. (In Swedish). Dep. NTIS (US Sales Only), PC A02/MF A01.

A system for recovery of heat from forgings in the Oeverum forge, Sweden is described. The hot forgings (about 700°C) passes through an air-coded cooling tunnel. The recovered heat is used for air conditioning. Besides the energy savings, an improvement in the working environment is noted.

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 18524, 19509, 19514

19033 (PB—80-102916) **Reclamation of alkaline ash piles and protection of their environment against dusting. Final report.** Wysocki, W. (Central Research and Design Inst. for Open-Pit Mining, Wroclaw (Poland)). Jul 1979. 279p. NTIS, PC A13/MF A01.

The objective of this study was to develop methods to reclaim and stabilize by vegetation fly ash and bottom ash from bituminous and lignite fired power plants. The ash had been transported from the power plant as a slurry and disposed of in ponds. Ashes from these power plants were strongly alkaline (pH from 8.5 to 12.8). Greenhouse experiments were conducted using white mustard (Synapis alba L.) as the test plant on ashes treated by various fertilizers, with various moisture levels and with application of amendments changing the composition or the properties of ash. Three years field experiments were performed to investigate the growth, health, yields and quality of mixtures of legumes and grasses growing on ashes with admixtures changing their composition or properties. Different fertilization levels were also studied. A 3-year field investigation of the growth and health of selected species of trees, bushes and cuttings was conducted. On the base of periodical pedological microbiological and phytosociological examination the process of the soil formation was observed. Field experiments were carried out in a moderate climate, where significant air pollution, dusts, and gases were emitted from nearby power plants burning bituminous coal or lignite. Along with the results of the greenhouse and field investigations, recommendations for ash reclamation are presented.

19034 (PB—80-106263) **Pavement recycling-bituminous concrete and concrete mix designs. Interim report, October 1978-March 1979.** Christman, R.; Lane, K. (Connecticut Dept. of Transportation, Wethersfield (USA). Bureau of Highways). Jul 1979. 76p. NTIS, PC A05/MF A01.

Trial mixes developed from both salvaged bituminous-concrete and portland-cement concrete pavement materials were tested in the laboratory. Salvaged materials investigated included crushed and cold-milled bituminous concrete and crushed 40 x 12-ft concrete pavement slabs with wire-mesh reinforcing. Laboratory results indicated the feasibility of full-scale bituminous recycling projects using central-plant mixing of salvaged and virgin aggregate by the heat-transfer method and both in-place full-depth and surface recycling. The concrete tests provided good results in terms of strength properties and demonstrated the potential of concrete recycling. Mesh separation and removal did not present any insurmountable problems. Experimental design and specifications for full-scale field projects are included for both recycled concrete and bituminous concrete, together with a plan for post-construction evaluation of the various recycled pavements.

MUNICIPALITIES AND COMMUNITY SYSTEMS

CONSERVATION SERVICES

REFER ALSO TO CITATION(S) 18938, 18939, 18941, 18942, 18944, 18945, 18947, 18989

PUBLIC UTILITIES

REFER ALSO TO CITATION(S) 18829

19035 (ANL/CNSV—6) **Reliability, maintainability, and availability engineering for integrated community energy systems.** Wang, P.Y.; Mavec, J.; Wolosewicz, R.M.; Calm, J.M.; Chopra, P.S. (Argonne National Lab., IL (USA)). Dec 1979. Contract W-31-109-ENG-38. 91p. Dep. NTIS, PC A05/MF A01.

The reliability, maintainability, and availability (RMA) engineering methodologies for integrated community energy systems (ICES) are reported. Since the tangible and intangible costs of a system failure may outweigh the benefits of the ICES approaches, RMA consideration must be an integral part of ICES engineering. The effectiveness of system planning and design depends on component reliability information and on forecasts of community load profiles. Supply subsystems must provide sufficient capacity to meet demands in spite of maintenance and unscheduled outages. This allowance is the major task of probabilistic system planning. Because reliability and maintainability performance is partially a random process, probabilistic methodology is required for analysis and comparison. Portions of a community energy system being modified or expanded may already be in use before additional portions reach the design stage. This situation presents an opportunity to extend the RMA assessment of the existing system and to improve the additions that will be made to it. RMA engineering is essential to all phases of planning, design, construction, and operation of ICES. The methodologies presented provide a systematic, disciplined approach to predict and analyze RMA, to determine corrective actions necessary, and to achieve performance goals.

19036 (DOE/CS/20289—1) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in the United States. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 90p. Dep. NTIS, PC A05/MF A01.

This report is one of a series of preliminary reports describing the laws and regulatory programs of the United States and each of the 50 states affecting the siting and operation of energy generating facilities likely to be used in Integrated Community Energy Systems (ICES). Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES. This report describes laws and regulatory programs in the United States. Subsequent reports will (1) describe public utility rate regulatory procedures and practices as they might affect an ICES, (2) analyze each of the aforementioned regulatory programs to identify impediments to the development of ICES, and (3) recommend potential changes in legislation and regulatory practices and procedures to overcome such impediments.

19037 (DOE/CS/20289—2) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Alabama. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 40p. Dep. NTIS, PC A03/MF A01.

The Alabama legislature has created the Public Service Commission which has general supervisory powers over utilities. The PSC consists of a president and two associates, who are elected to four-year terms. The PSC has no jurisdiction over municipal utilities and, as a result, local governments retain the power to regulate the operation of their municipally-owned utilities. Municipalities also retain their police power over streets and highways within their territory. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19038 (DOE/CS/20289—3) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Alaska. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 40p. Dep. NTIS, PC A03/MF A01.

The Alaska Public Utilities Commission is a subagency of the Department of Commerce and Economic Development Department. The Department has general authority to enforce state laws regulating public utilities. The Commission (formerly called the Public Service Commission) was created in 1959. It is made up of five members appointed by the governor and confirmed by the legislature. One of the members is designated by the governor as chairman of the Commission. Members serve six-year terms with the exception of the chairman who serves a four-year term. Members must be qualified as follows: one must be an attorney, one must be an engineer, one must be a graduate of an accredited university with a major in finance, accounting, or business administration, and two must be consumers. The role of local governments in regulating public utilities subject to Commission jurisdiction is limited to the imposition of reasonable fees and conditions for the use of streets and other public property. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19039 (DOE/CS/20289—5) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Arkansas. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 50p. Dep. NTIS, PC A03/MF A01.

The Arkansas state constitution contains no provision dealing with public utility regulation. Title 73 of the Arkansas Statutes specifically provides for the regulation of public utilities. The Arkansas Public Service Commission is established by statute as a subagency of the Department of Commerce and is responsible for regulating electric, steam heating, and certain other kinds of utilities. The Commission consists of three members, each appointed by the governor with the approval of the Senate for a term of six years. The Commission has authority over all matters pertaining to the regulation and operation of gas companies, electric companies, and hydroelectric companies among other utilities enumerated in the statute. The role of local governments in the regulation of public utilities has been reduced by recent legislation. Municipal councils formerly had the power to regulate rate-making for investor owned utilities operating within their boundaries. However, as a result of 1977 amendments to the Public Utilities Act, ratemaking for privately owned electric, gas, telephone, and sewer utilities is now within the exclusive jurisdiction of the Public Service Commission. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19040 (DOE/CS/20289—6) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in California. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 56p. Dep. NTIS, PC A04/MF A01.

The Constitution of the State of California grants to the Legislature control over persons and private corporations that own or operate a line, plant, or system for the production, generation, or transmission of heat, light, water, or power to be furnished either directly or indirectly to or for the public. The Constitution establishes the Public Utilities Commission and grants certain specific powers to the PUC, including the power to fix rates, establish rules and prescribe a uniform system of accounts. The Constitution also recognizes that the Legislature has plenary power to confer additional authority and jurisdiction upon the PUC. The Constitution prohibits regulation by a city, county, or other municipal body of matters over which the Legislature has granted regulatory power to the PUC. This provision does not, however, impair the right of any city to grant franchises for public utilities. The California legislature has enacted the California Public Utilities Code and has designated the PUC as the agency to implement the regulatory provisions of the Code. The Public Utilities Commission consists of five members appointed by the governor and approved by the senate, a majority of the membership concurring, for staggered 6-year terms. Certain limited powers over the conduct of public utilities may still be exercised by municipalities. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19041 (DOE/CS/20289—7) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Colorado. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 57p. Dep. NTIS, PC A04/MF A01.

The Colorado constitution designates the Public Utilities Commission as the agency responsible for the regulation of public utilities. The Commission has been established as a subagency of the Department of Regulatory Agencies. The Commission consists of three members appointed by the governor with the consent of the senate. The term of office for commissioners is six years. The Colorado constitution provides that all power to regulate the facilities, service and rates, and charges of every public utility is vested in the Commission. Municipalities may, however, authorize a person to build water, gas, geothermal, solar, or electric light works beyond the limits of the city for the purpose of supplying its residents and can authorize such person to collect a rental fee from each person served. Beyond this authority, the role of local government in regulating public utilities is limited to the exercise of reasonable police and licensing powers as well as the power to grant franchises. There is no statutory procedure by which decisions of local governments concerning utilities are made subject to appeal or review by the Commission. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19042 (DOE/CS/20289—7) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in the United States. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 103p. Dep. NTIS, PC A06/MF A01.

This report is a summary of a series of preliminary reports describing the laws and regulatory programs of the United states and each of the 50 states affecting the siting and operation of energy generating facilities likely to be used in Integrated Community Energy Systems (ICES). A brief summary of public utility regulatory programs, energy facility siting programs, and municipal franchising authority is presented in this report to identify how such programs and authority may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES. Subsequent reports will (1) describe public utility rate regulatory procedures and practices as they might affect an ICES, (2) analyze each of the aforementioned regulatory programs to identify impediments to the development of ICES, and (3) recommend potential changes in legislation and regulatory practices and procedures to overcome such impediments.

19043 (DOE/CS/20289—8) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Connecticut. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 62p. Dep. NTIS, PC A04/MF A01.

The Connecticut statutes expressly provide for the regulation of public utilities. As of January 1, 1979, responsibility for the regulation of utilities is vested in the Public Utilities Control Authority (PUCA). Formerly such authority was exercised by the Public Utilities Commission which has been abolished and replaced by the PUCA. The Public Utilities Act provides that the PUCA is to consist of five members appointed by the governor with the advice and consent of both houses of the general assembly. It should be noted that statutory references to the Public Utilities Commission are deemed to mean the Public Utilities Control Authority. The statute gives only a minor role to local government in regulating public utilities. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19044 (DOE/CS/20289—9) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Delaware. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 37p. Dep. NTIS, PC A03/MF A01.

The regulation of public utilities in Delaware is the responsibility of the Public Service Commission (PSC). The PSC consists of five commissioners appointed by the governor and confirmed by a majority of the senate for terms of five years each. Not more than three members are to be from the same political party. One member is to be a resident of Kent County, one of Sussex County, one of the City of Wilmington, and two members are to be of New Castle County outside of Wilmington. Local governments retain control over the rates, property, equipment, facilities, and franchises of municipally owned utilities. Such utilities are expressly exempted from PSC regulation. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19045 (DOE/CS/20289—10) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Florida. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 53p. Dep. NTIS, PC A04/MF A01.

The authority to regulate public utilities is vested generally in the Florida Public Service Commission. The Commission is comprised of five members appointed by the governor with the approval of the senate. The governor must choose his appointees from a list of persons recommended by the nine-person Florida Public Service Commission Nominating Council. Commissioners serve either three- or four-year terms. They must be free from any employment or pecuniary interests in any utility subject to the jurisdiction of the Commission. Within the purview of its powers, the authority of the Commission supersedes that of local governments. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19046 (DOE/CS/20289—11) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Georgia. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 36p. Dep. NTIS, PC A03/MF A01.

The authority to regulate public utilities is vested generally in the Public Service Commission. The Commission is composed of five members elected to six-year terms by the general electorate. Commissioners must be free of employment or pecuniary interests which are incompatible with the duties of the Commission. The Commission is the only agency that may exert regulatory control over public utilities. The legislature has delegated no regulatory authority to local government. Except for the powers incident to granting a franchise and its normal police powers, municipal corporations do not have any role in the supervision of public utilities. The Commission's general supervisory authority does not extend to public utilities owned or operated by municipal corporations. The jurisdiction of the Commission extends to several specific public utilities, including gas or electric light and power companies. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19047 (DOE/CS/20289—12) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Hawaii. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 37p. Dep. NTIS, PC A03/MF A01.

The authority to regulate public utilities in Hawaii is vested in the Public Utilities Commission. The Commission is composed of three members appointed by the Governor. Commissioners serve for six year terms, must be independent of the companies they regulate and must not possess or acquire an interest in any public utility. The regulatory authority of the Commission preempts that of any other state agency. Local governments have no authority over public utilities. Chapter 196 of the Hawaii statutes establishes the position of the Energy Resources Coordinator; the role of the coordinator, however, is merely to develop, review, and recommend programs for the optimum development of Hawaii's energy resources. The Commission has jurisdiction over all public utilities located in the state. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19048 (DOE/CS/20289—13) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Idaho. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 37p. Dep. NTIS, PC A03/MF A01.

The Idaho state legislature has created the Idaho Public Utilities Commission and has given the Commission the power and jurisdiction to supervise and regulate every public utility in the state. The Commission is comprised of three members appointed by the governor with the approval of the senate. Commissioners serve full time and are appointed for six year terms. No more than two of the members may be from the same political party. Title 61 of the Idaho Code, which establishes the Commission and delineates its powers, vests all regulatory responsibility in the Commission to the exclusion of local government. However, as an incident to their franchising power, municipalities may impose reasonable regulations on the use of their streets. The Idaho Supreme Court holds that the transfer of regulatory power over public utilities to the Commission did not diminish the powers and duties of municipalities to control and maintain their streets and alleys. Limited statutory authority also exists giving municipalities the power to regulate the fares, rates, rentals, or charges made for the service rendered under any franchise granted in such city, except such as are subject to regulation by the Public Utilities Commission. With the exception of this limited power, the Commission is the sole agency having regulatory power over Idaho public utilities. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19049 (DOE/CS/20289—14) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regula-**

tory programs in Illinois. Preliminary background report. Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 42p. Dep. NTIS, PC A03/MF A01.

The authority to regulate public utilities is vested generally in the Illinois Commerce Commission, comprised of five members appointed by the governor with the advice and consent of the senate and appointed for five year terms. They must be free from any employment or pecuniary interests in any business subject to regulation by the Commission. Local governments may exercise a large degree of regulatory authority over public utilities providing services within a municipality. The question of whether a municipality will exercise regulatory control over local public utilities must be put to the voters of the city. If the proposition is approved by a majority of the voters, the municipality may regulate services and rates and exercise most of the regulatory functions otherwise assigned to the Commission. If any public utility is dissatisfied with any action of a municipality, the utility is entitled to apply to the Commission for review of the action. On review, the Commission may take any determination which it deems just and reasonable. In addition, municipally-owned utilities are excluded specifically from the definition of public utility. These utilities are not within the jurisdiction of the Commission and are regulated locally. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19050 (DOE/CS/20289—15) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Indiana. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 32p. Dep. NTIS, PC A03/MF A01.

The authority to regulate public utilities is vested generally in the Public Service Commission of Indiana. The Commission is comprised of three members appointed by the governor. Commissioners are appointed for four-year terms. They must be free from any employment or pecuniary interest in any public utility. Indiana courts have stated that the Commission was created and vested with regulatory authority over public utilities in order to relieve these utilities from local regulation. Local governments do, however, have specific statutory authority to determine, by contract or ordinance, the quality and character of service to be provided by public utilities within the municipality. Local governments may also regulate the use of streets and other public property by public utilities. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19051 (DOE/CS/20289—16) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Iowa. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 35p. Dep. NTIS, PC A03/MF A01.

The authority to regulate public utilities is vested generally in the Iowa State Commerce Commission. The Commission is comprised of three members appointed by the governor with the approval of two-thirds of the senate. Commissioners are appointed for six-year terms. They must be free from employment or pecuniary interests in any public utility. Although the right to grant franchises is specifically reserved for municipalities, local governments exercise no regulatory authority over the provision of utility services by public utilities. Municipally-owned utilities, however, are specifically excepted from rate regulation by the Commission. The regulation of rates charged by municipally-owned utilities is the responsibility of local governments. The Commission is given no authority to review decisions of local governments with respect to rates. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19052 (DOE/CS/20289—17) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Kansas. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 39p. Dep. NTIS, PC A03/MF A01.

The Kansas legislature has created the State Corporation Commission and given the Commission full power, authority, and jurisdiction to supervise and control public utilities. The Commission is empowered to do all things necessary and convenient for the exercise of such power, authority and jurisdiction. The Commission is composed of three members, appointed by the governor by and with the consent of the senate. The Commissioners' appointment is for a four year term. The Commission elects one of its members as chairperson. The Kansas statutes provides that the power and authority to control and regulate all public utilities and common carriers situated and operated wholly or principally within any city or principally operated for the benefit of such city or its people, shall be vested exclusively in such city. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19053 (DOE/CS/20289—18) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Kentucky. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 48p. Dep. NTIS, PC A03/MF A01.

Until April 1, 1979, the Public Service Commission had been vested with exclusive jurisdiction over the regulation of rates and service of utilities. As of that date two new agencies, the Energy Regulatory Commission (ERC) and the Utility Regulatory Commission (URC), have replaced the Public Service Commission. The ERC consists of three full-time members appointed by the governor for four year terms and is responsible for enforcing the provisions of the Kentucky statutes relating to electric and gas utilities. The three-member URC is responsible for enforcing the provisions relating to non-energy utilities such as telephone, sewer, and water utilities. The statutes vest all regulatory authority over public utilities in either the ERC or the URC. Local governments retain only the power to grant local franchises. However, it should be noted, that any utility owned or operated by a political subdivision of the state is exempt from regulation. Thus, local government has complete authority over utilities which are self-owned. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19054 (DOE/CS/20289—19) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Louisiana. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 39p. Dep. NTIS, PC A03/MF A01.

The authority to regulate public utilities is vested generally in the Louisiana Public Service Commission, composed of five members elected by the general electorate and elected for six-year terms. The Commission is charged with regulating all public utilities and has such other regulatory authority as provided by law. The Commission, however, has no power to regulate a public utility owned, operated, or regulated on the effective data of this constitution [1921] by the governing authority of one or more political subdivisions unless the Commission is authorized to regulate these utilities by the electorate of the political subdivision involved. An additional statutory provision excludes all municipally-owned public utilities from Commission regulation. New Orleans has retained the regulatory authority which it held as of the effective date of the Louisiana Constitution. Therefore, the Commission exercises no regulatory powers over investor or municipally-owned utilities in New Orleans. A municipality is empowered to own and operate a revenue-producing public utility within or without its boundaries and it may sell and distribute the commodity or service of the public utility within or without its corporate limits and may establish rates, rules, and regulations with respect to the sale and distribution. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19055 (DOE/CS/20289—20) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Maine. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 40p. Dep. NTIS, PC A03/MF A01.

The Maine Supreme Court holds that the regulation of the operations of public utilities is an exercise of the police powers of the state. The legislature has delegated such regulatory authority to the Maine Public Utilities Commission (PUC). The statutes provide no role for local government in the regulation of public utilities. The PUC consists of three full time members, appointed by the Governor subject to review by the Joint Standing Committee on Public Utilities and to confirmation by the Legislature. They each serve seven year terms. One member is designated by the Governor as chairman. The Commission appoints a secretary, assistant secretary, director of transportation, and, with the approval of the Attorney General, a general counsel. A member of the PUC cannot have any official or professional connection or relation with or hold any stock or securities in any public utility. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19056 (DOE/CS/20289—21) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Maryland. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 59p. Dep. NTIS, PC A04/MF A01.

The authority to regulate public utilities in Maryland is vested in the Public Service Commission under the authority of the Public Service Commission Law. The Commission consists of five commissioners who are appointed by the governor with the advice and consent of the Senate. Commissioners must be or become citizens of Maryland, at least three are to serve full time, and one of the commissioners is to be nominated as chairman. The tenure of each commissioner is six years and their terms are on a staggered schedule. Commissioners are eligible for reappointment. The Public Service Commission Law provides that the Commission's powers an jurisdiction shall extend to the full extent permitted by the Constitution and laws of the United States. Local governments in Maryland are not given regulatory power over public service companies. The only power that local governments have over the operations of utilities is the power to grant franchises. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19057 (DOE/CS/20289—22) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Massachusetts. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 44p. Dep. NTIS, PC A03/MF A01.

The authority to regulate public utilities is vested generally in the Department of Public Utilities. The Department is under the supervision and control of a commission consisting of three members appointed by the governor for terms of four years. No more than two of the commissioners may be members of the same political party. Commissioners must be freee from any employment or financial interests which are incompatible with the duties of the Department. The Department is responsible for regulating public utilities. The Department is specifically granted general supervisory authority over all gas and electric companies. Specific provisions for the appeal of local decisions exist only in the case of a municipality's approval or disapproval of new operaions by an electric or gas company in a municipality already being served by another such utility. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19058 (DOE/CS/20289—23) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Michigan. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 32p. Dep. NTIS, PC A03/MF A01.

The authority to regulate public utilities is vested generally in the Michigan Public Service Commission. The Commission is composed of three members appointed by the Governor with the advice and consent of the senate. Commission members are appointed for six-year terms. They must be free from pecuniary and employment interests incompatible with the duties of the Commission. The Commission is vested with complete power and jurisdiction to regulate all public utilities in the state except any municipally-owned utility. The Commission may not change any rates fixed in or regulated by a franchise granted by a municipality. Upon submission to the Commission by the municipality and the public utility operating in the municipality, the Commission may investigate and fix rates and establish rules and conditions of service. The jurisdiction of the Commission extends to all public utilities except municipally-owned utilities. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19059 (DOE/CS/20289—24) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Minnesota. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 58p. Dep. NTIS, PC A04/MF A01.

The Minnesota Public Service Commission (PSC) in the Department of Public Service is authorized by statute to regulate public utilities. The PSC consists of five members appointed by the governor with the advice and consent of the senate to terms running for six years. Not more than three commissioners are to belong to the same political party. The commissioners are not to derive any significant portion of their income directly or indirectly from any public utility. Municipalities also have a limited role in the regulation of public utilities. If the municipality controls the exercise of a public utility franchise, it is authorized to assist the PSC as amicus curiae in proceedings with respect to the rates, fares, prices, regulation, or control of a utility operating in the municipality. Municipal utilities are exempt from regulation by the PSC because municipal utilities are presently effectively regulated by the residents of the municipalities which own and operate them. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19060 (DOE/CS/20289—25) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Mississippi. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 48p. Dep. NTIS, PC A03/MF A01.

The authority to regulate public utilities in Mississippi is vested generally in the Public Service Commission, composed of three members elected for four year terms from separate districts of the state. Within the purview of its powers, the authority of the Commission supersedes that of local governments. It is empowered to amend municipal franchises that contain provisions conflicting with its exclusive jurisdiction over the rates and standards of service of public utilities. Local governments play a role in regulating public utilities only through the exercise of their zoning and franchising powers. They may also operate their own utilities which are totally exempt from Commission control, unless they provide services more than one mile beyond their corporate boundaries. Other than a procedure in which certain provisions in municipal franchises may be subject to modification by the Commission, there is no process by which the decisions of local government respecting utilities are reviewed by the Commission. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19061 (DOE/CS/20289—26) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Missouri. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 56p. Dep. NTIS, PC A04/MF A01.

The authority to regulate public utilities in Missouri is vested in the Public Service Commission. The Commission is composed of five members who are appointed by the governor with the advice and consent of the senate. Commissioners are appointed for a term of six years. Commissioners must be free from any employment or pecuniary interests incompatible with the duties of the Commission. The Commission is charged with the general supervision of public utilities. The Public Service Commission Law passed in 1913, makes no provision for the regulation of public utilities by municipalities. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19062 (DOE/CS/20289—27) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Montana. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 58p. Dep. NTIS, PC A04/MF A01.

Authority to regulate the operations of public utilities in Montana is generally vested in the Public Service Commission. The Commission is composed of five members elected for four year terms from separate districts of the state. Within the purview of its powers, the authority of the Commission supersedes that of local governments. Its powers, however, are generally limited to the regulation of rates and the adequacy of service of established enterprises. Outside of these areas, and until the Commission exerts its authority, the police powers of municipal governments to regulate utilities are unimpaired. Local governments do play a subsidiary role in regulating public utilities, although it is not indicated by the legislation creating the Commission. The Board of Natural Resources and Conservation (Board) has independent authority to regulate the operations of those utility facilities requiring certification under the Major Facility Siting Act. The jurisdiction of the Commission extends to all public utilities, defined broadly enough to include any foreseeable ICES project. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19063 (DOE/CS/20289—28) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Nebraska. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 65p. Dep. NTIS, PC A04/MF A01.

The state agency with principal authority to regulate electric public utilities is the Power Review Board (Board). However, the Board in fact, exercised little regulatory authority over heat and power utilities because all electrical power in Nebraska is currently supplied by public authorities and is not subject to regulation by the Board. Gas and water utilities are also subject to general supervision by municipalities. The Board is compised of five members - an attorney, an engineer, one accountant, two lay - persons appointed by the governor and confirmed by the legislature. All members are appointed to overlapping four-year terms, and none may serve more than two consecutive terms. Decisions by the Board require the approval of a majority of its members. The Public Service Commission of Nebraska is a constitutionally created body. Its powers and duties include the regulation of rates, service, and general control of common carriers as the legislature may provide by law. Other state agencies also possess limited regulatory jurisdiction which may be relevant to an energy facility. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19064 (DOE/CS/20289—29) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Nevada. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 52p. Dep. NTIS, PC A04/MF A01.

The authority to regulate the operatons of public utilities in Nevada is vested generally in the Public Service Commission. The Commission is comprised of three members appointed by the governor to four year terms. One of the members is designated by the governor to act as chairman and serves in that capacity at the pleasure of the governor. Commissioners must be free from employment or pecuniary interests which are incompatible with the duties of the Commission. Within the purview of its powers, the authority of the Commission supercedes that of local governments. Local governments play a role in regulating public utilities only through the exercise of their zoning and franchising powers. In addition, municipally-owned utilities are totally exempt from Commission control. No specific procedure is provided by which the decisions of local governments regarding utilities may be reviewed by the Commission. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19065 (DOE/CS/20289—30) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in New Hampshire. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 42p. Dep. NTIS, PC A03/MF A01.

Public utilities in New Hampshire are regulated by the Public Utilities Commission. The Commission is comprised of three members appointed for six-year terms by the Governor with the advice and consent of the council. Members of the Commission must be free from any employment or pecuniary interests in any public utility. The Commission is charged with the general regulation and supervision of public utilities. Within the purview of its powers, the authority of the Commission supercedes that of local government. The Commission may suspend the operation of local zoning laws. Local governments do retain the right to license the use of public ways by utilities. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19066 (DOE/CS/20289—31) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in New Jersey. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 64p. Dep. NTIS, PC A04/MF A01.

The authority to regulate the operations of public utilities in New Jersey is generally vested in the Board of Public Utilities. The Board is subsumed within the Department of Energy for administrative purposes, but functions largely independently of supervision or control by that agency. The Board is composed of three members who serve for six-year terms. They are appointed by the governor with the advice and consent of the senate. Within the purview of its powers, the authority of the Board supersedes that of local governments. The Board, for example, may grant exemptions from local zoning provisions, and has approving authority over privileges or franchises granted by municipalities to public utilities. The Board, however, cannot override the refusal of a municipality to grant consent to the initiation of operations by a public utility. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19067 (DOE/CS/20289—32) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in New Mexico. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 32p. Dep. NTIS, PC A03/MF A01.

The authority to regulate public utilities is vested generally in the New Mexico Public Service Commission. The Commission is composed of three members appointed by the governor with the advice and consent of the senate. Commission members, who are to be competent persons and qualified electors of [New Mexico], are appointed for six year terms. They must be free from any pecuniary or employment interests incompatible with the duties of the Commission. The Commission possesses the exclusive power to regulate public utilities. The Commission, however, exercises no authority over utilities owned by municipal corporations or H class counties (counties under 54 square miles in area) unless the general electorate of the municipality or county elects to bring such utilities within the jurisdiction of the Commission. Municipalities may establish by contract, rates between the municipality and investor-owned utilities. Such contracts are limited to 25 years in duration and are subject to Commission approval. There is no specific procedure for review of local decisions regarding municipally-owned utilities. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19068 (DOE/CS/20289—33) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in New York. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 58p. Dep. NTIS, PC A04/MF A01.

The authority to regulate public utilities is vested generally in the New York Public Service Commission. The Commission is composed of five members appointed by the governor with the advice and consent of the senate. Commissioners are appointed for

six-year terms. Commissioners may not have any pecuniary or financial interest in any public utility. Local governing bodies are authorized to exercise such power, jurisdiction and authority in enforcing the laws of the state and the orders, rules, and regulations of the commission as may be prescribed by statute or by the commission with respect to public utilities. A Commission spokesman confirmed that no statutes have been passed pursuant to this provision and the Commission has not ceded any of its regulatory powers to local governments. With the exception of the granting of franchises and permits to use public ways, local governments exercise no regulatory powers over public utilities. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19069 (DOE/CS/20289—34) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in North Carolina. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 54p. Dep. NTIS, PC A04/MF A01.

Under the Public Utilities Act of 1965, utilities in North Carolina are regulated by the State's Utility Commission. The Commission consists of seven members who are appointed by the governor, subject to confirmation by the General Assembly sitting in joint session. The Commissioners serve eight year terms and the governor designates one of the commissioners as chairman. The Commission has an office of the executive director, who is appointed to a six year term by the governor subject to confirmaion by the General Assembly. The executive director heads the Commission's public staff. The public staff's duties include reviewing, investigating, and making recommendations on utility rates and services and intervention on behalf of the public in proceedings affecting consumer rates and generating plant certification. The Commission has the same power to regulate the operation of privately-owned public utilities within municipalities as it has to control those ouside. The only power over privately-owned utilities reserved to the municipalities is the power to grant franchises. A municipality may maintain its own utility systems, and such systems are not subject to the control and jurisdiction of the Commission. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19070 (DOE/CS/20289—35) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in North Dakota. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 55p. Dep. NTIS, PC A04/MF A01.

The North Dakota Public Service Commission (PSC) is a constitutional body responsible for the regulation of all public utilities. The PSC is composed of three elected commissioners who serve for six year terms. Section 83 of the state's Constitution gives the legislature the power to prescribe the powers and duties of the PCS. Pursuant to this authorization, the legislature adopted Title 49 of the North Dakota Century Code prescribing the jurisdiction as well as the powers and duties of the PSC. It also prescribes various rules and regulations pertaining to electric, gas, and other public utilities. All authority over public utilities is vested in the PSC. Local governments, except for the powers inherent in their franchising and zoning authority, are not given any control over utility regulation. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19071 (DOE/CS/20289—36) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Ohio. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 52p. Dep. NTIS, PC A04/MF A01.

The Public Utilities Commission (PUCO) is a body created by the Ohio State legislature to administer the provisions of the Ohio Public Utilities Act. It is composed of three commissioners appointed by the governor with the advice and consent of the senate. Once appointed, a commissioner serves for a six-year period. The PUCO is vested with the power and jurisdiction to supervise and regulate public utilities and railroads... . The term public utility includes every corporation, company, co-partnership, person or association, their lessees, trustees, or receivers as defined in the Ohio Code. Among the various services enumerated in the Code under the definition of public utility are an electric light company; a gas company; a pipeline company transporting gas, oil or coal; a waterworks company; a heating or cooling company. The power to regulate public utilities is shared by the PUCO and municipal governments. The municipal regulatory authority is derived from the Ohio Constitution, statutory provisions, and municipal franchising authority. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19072 (DOE/CS/20289—37) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Oklahoma. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 59p. Dep. NTIS, PC A04/MF A01.

The Oklahoma Corporation Commission was created by the state constitution, for the purpose of regulating transportation and transmission companies. The Constitution also provides that the Commission may be vested with such additional powers, and charged with such other duties (not inconsistent with this Constitution). Pursuant to this power to regulate the legislature has given the Commission the power to regulate certain public utilities, including electric, gas, and steam. The Commission is composed of three members who are elected to staggered, six-year terms. A commissioner may not have any interests incompatible with the duties of the Commission. The Commission is charged with the general supervision of public utilities. Local governments have no role in the regulation of public utilities although municipalities do have the power to grant franchises. The constitution allows the legislature to pass laws giving cities, towns, and counties the right to regulate the rates and services of their franchises operating within the boundaries of the city, town, or county, although there are no such laws in effect at the present time. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19073 (DOE/CS/20289—38) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Oregon. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 48p. Dep. NTIS, PC A03/MF A01.

The authority to regulate public utilities is vested generally in the Public Utility Commissioner of Oregon. The Commissioner is appointed by the governor, subject to confirmation by the senate, for a term of four years. He must be free of any pecuniary or employment interest in any business subject to the jurisdiction of the Commissioner. While the Commissioner is primarily responsible for regulating public utilities, local governments do retain some control over utility operations within municipal boundaries. A local government may determine by contract or prescribe by ordinance the quality and character of service furnished by a public utility and may control the use of streets and other public property by public utilities. Municipalities may require public utilities to make any modifications, additions, or extensions to facilities as are necessary to the public interest. In addition, local governments may fix, by contract or ordinance, the rates to be charged by public utilities furnishing service within a municipality. The Commissioner, however, has the power to review any of the above-described local actions. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19074 (DOE/CS/20289—39) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Pennsylvania. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 65p. Dep. NTIS, PC A04/MF A01.

The authority to regulate public utilities is generally vested in the Pennsylvania Public Utility Commission. The Commission is comprised of five members appointed by the governor with the advice and consent of two-thirds of the senate. Commission members are appointed for 10 year terms. They must be free from any employment which is incompatible with the duties of the Commission, and are subject to a statutory code of ethics. The Commission is

charged with responsibility for enforcing the Public Utility Law. Within the purview of its powers, the authority of the Commission supersedes that of local governments. The Commission, for example, may grant exemptions from local zoning requirements, and has approving authority over privileges or franchises granted by municipalities to public utilities. The Commission, however, has no authority over municipally owned utilities operating within municipal boundaries. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19075 (DOE/CS/20289—40) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Rhode Island. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 45p. Dep. NTIS, PC A03/MF A01.

The Rhode Island statutes vest in the Public Utility Commission and the Division of Public Utilities the exclusive power and authority to regulate public utility companies in that state. Both bodies have been established within the Department of Business Regulation but are independent of the Department's director and are not under his jurisdiction. The jurisdiction to regulate utilities is shared by the Commission and the Division. The Commission serves as a quasi-judicial tribunal with jurisdiction, powers, and duties to hold investigations and hearings involving rates, sufficiency and resonableness of facilities, gas, electric, water, and pipeline public utilities. The administrator, who is chief executive officer of the Division, is responsible for exercising the jurisdiction, supervision, powers, and duties not specifically assigned to the Commission. By virtue of his office, the chairman of the Commission serves also as the administrator and he supervises and directs the execution of all laws relating to public utilities and carriers and all regulations and orders of the Commission governing the conduct and charges of public utilities. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19076 (DOE/CS/20289—41) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in South Carolina. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 58p. Dep. NTIS, PC A04/MF A01.

Pursuant to constitutional South Carolina mandate the General Assembly has created the Public Service Commission. The Commission is composed of seven members elected to four year terms by the General Assembly. One commissioner is elected from each of seven districts corresponding to the congressional districts as they existed as of January 1, 1930. The commissioners elect one of their members as chairman. The South Carolina statutes contain separate chapters dealing with the regulation of public utilities and electric utilities. Public utility includes the furnishing of gas or heat (other than by means of electricity) to the public. While the Commission is granted general supervisory and regulatory powers over public utilities and electric utilities, total governments retain some control over electrical utilities. All municipality's have the power to grant exclusive franchises to such utilities for the furnishing of light to the municipality and its inhabitants. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19077 (DOE/CS/20289—42) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in South Dakota. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 48p. Dep. NTIS, PC A03/MF A01.

The South Dakota Public Utilities Commission is authorized by statute to regulate gas and electric utilities. The Commission consists of three elected commissioners each of whom serves for a six year term. The Commissioners are elected by district and each must, at the time of election, be a resident of the district from which he has been elected. Each Commissioner must reside in the state capital and devote his entire time to the duties of his office. The Commission is part of the Department of Commerce and Consumer Protection. Municipal power to regulate privately owned electric and gas public utilities was terminated in 1975. A municipally-owned electric utility has the authority to regulate the sale, use, and rates of electric power and energy which it provides. The Commission has no authority to regulate steam, heat, and refrigeration systems; that power resides in cities. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19078 (DOE/CS/20289—43) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Tennessee. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 30p. Dep. NTIS, PC A03/MF A01.

The Tennessee Public Service Commission has been designated by the legislature as the agency primarily responsible for the regulation of public utilities and carriers. The Commission is comprised of three members elected by the voters of the state. Each member of the Commission serves a six-year term. The Commission is given broad supervisory control over public utilities in the public utilities statute. Included under its authority is the power to determine whether a privilege or franchise granted to a public utility by a municipality is necessary and proper for the public convenience. No privilege or franchise is valid until it has been approved by the Commission. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19079 (DOE/CS/20289—44) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Texas. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 35p. Dep. NTIS, PC A03/MF A01.

The authority to regulate public utilities in Texas is generally vested in the Public Utilities Commission. The Commission is comprised of three members appointed by the governor, with the advice of at least two-thirds of the senate, for a six-year term. Prior to the passage of the Texas Public Utility Regulatory Act (PURA) in 1975, the power to regulate public utilities was vested almost exclusively in municipalities. Under PURA, municipalities retain exclusive original jurisdiction over all electric, water, and sewer utilities within the municipality. PURA provides that all regulations pertaining to public utilities promulgated by local regulatory agencies remain in effect unless they are superceded by Commission rules. The municipality's governing body is required to exercise its regulatory authority under rules and standards consistent with those promulgated by the Commission. The Commission has exclusive appellate jurisdiction to review orders and ordinances of regulatory municipalities. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19080 (DOE/CS/20289—45) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Utah. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 34p. Dep. NTIS, PC A03/MF A01.

The authority to regulate public utilities is vested generally in the Utah Public Service Commission comprised of three members appointed by the governor with the consent of the State Senate. Commission members are appointed for six-year terms and must be free from employment and pecuniary interests incompatible with the duties of the Commission. The Commission is charged with the general supervision of public utilities, but its authority does not extend to municipally-owned utilities. Local governments are forbidden from exercising any regulatory powers over public utilities unless the utility is municipally-owned. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19081 (DOE/CS/20289—46) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Vermont. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan

1980. Contract AC02-78CS20289. 36p. Dep. NTIS, PC A03/MF A01.

The authority to regulate public utilities is vested generally in the Vermont Public Service Board (PSC). The PSB is comprised of three members appointed by the governor with the advice and consent of the senate. PSB members serve six year terms. Members must be free from any employment or pecuniary interests in any company subject to the supervision of the PSB. Local governments retain little regulatory authority over public utilities. Local governments are responsible for regulating the use of streets and other public property, but any person aggrieved by a local decision may appeal to the PSB within thirty days. The PSB is to review the local action at a public hearing and its decision is final. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19082 (DOE/CS/20289—47) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Virginia. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 35p. Dep. NTIS, PC A03/MF A01.

The authority to regulate public utilties is vested generally in the State Corporation Commission. The Commission is comprised of three members elected by a joint vote of the two houses of the general assembly. Commissioners serve six-year terms. They must be free from any employment or pecuniary interests in any company subject to the supervision and regulation of the Commission. The Commission is charged with the primary responsibility of supervising and regulating public utilities. However, local governments retain the power to grant franchises and otherwise regulate the use of streets and other public property. In addition, municipally-owned utilities are not within the jurisdiction of the Commission to the extent that they operate within corporate limits. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19083 (DOE/CS/20289—48) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Washington. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 74p. Dep. NTIS, PC A04/MF A01.

The Washinton State Constitution grants authority to the legislature to regulate railroads and other common carriers as well as telegraph and telephone companies in the state. No section of the constitution expressly provides for the regulation of electric, gas, water, or heating utilities. The authority to regulate public utilities is vested generally in the Utilities and Transportation Commission, formerly designated at the Public Service Commission. The Commission is composed of three members appointed by the governor, with the consent of the senate. The term of office for commissioners is six years. Recently enacted legislation provides for the implementation of tax incentives to encourage the development of cogeneration facilities in the state. This plan is to be administered by the Department of Revenue in conjunction with the Energy Office. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19084 (DOE/CS/20289—49) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in West Virginia. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 31p. Dep. NTIS, PC A03/MF A01.

The authority to regulate public utilities is vested generally in the West Virginia Public Service Commission, comprised of three members appointed by the governor with the advice and consent of the state senate. Commissioners are appointed for six year terms. They must be free from any pecuniary or employment interest in public utilities. The Commission possesses the exclusive authority to regulate public utilities. While local governments retain the power to control the use of their streets and to grant franchises to public utilities, they cannot use this power to infringe on the exercise of regulatory power by the Commission. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19085 (DOE/CS/20289—50) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Wisconsin. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 43p. Dep. NTIS, PC A03/MF A01.

The Wisconsin state legislature has designated the Public Service Commission (PSC) as the agency responsible for regulating public utilities, and has prescribed the manner in which such utilities are to be regulated. The PSC consists of three commissioners appointed to staggered six-year terms by the governor and confirmed by the senate. Municipalities are given certain limited regulatory powers over public utilities. They are allowed to determine the quality and character of each kind of product or service to be rendered by any public utility within the municipality; to determine all other terms and conditions upon which a public utility may be permitted to occupy the streets, highways or other public places within the municipality; and may require such additions and extensions to [a public utility's] physical plant within said municipality as shall be reasonable and necessary in the interest of the public, and to designate the location and nature of all such additions and extensions subject to review by the PSC. However, the PSC has original and concurrent jurisdiction with municipalities to require extensions of service and to regulate service. Municipalities may purchase and own public utilities; however, such utilities are subject to regulation by the PSC. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

19086 (DOE/CS/20289—51) **Study of the impacts of regulations affecting the acceptance of Integrated Community Energy Systems: public utility, energy facility siting and municipal franchising regulatory programs in Wyoming. Preliminary background report.** Feurer, D.A.; Weaver, C.L.; Gallagher, K.C.; Hejna, D.; Rielley, K.J. (Ross, Hardies, O'Keefe, Babcock and Parsons, Chicago, IL (USA)). Jan 1980. Contract AC02-78CS20289. 39p. Dep. NTIS, PC A03/MF A01.

The authority to regulate public utilities is vested in the Wyoming Public Service Commission. The Commission is comprised of three members appointed by the Governor with the advice and consent of the state senate. Each member of the Commission serves a six-year term and no more than two members may be from the same political party. The Commission has exclusive regulatory authority over public utilities. The statutory definition of public utility, however, does not include municipally-owned and operated utility systems to the extent they provide services within the municipality. Such utilities are regulated locally. The Commission reviews no documentation of rates or services of municipallyy-owned systems. Public utility regulatory statutes, energy facility siting programs, and municipal franchising authority are examined to identify how they may impact on the ability of an organization, whether or not it be a regulated utility, to construct and operate an ICES.

MUNICIPAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 18524, 18527

19087 (PB—295680) **Recycling in your community: a guide to make it happen.** (Fresno County Economic Opportunities Commission, CA (USA)). Mar 1979. 73p. NTIS, PC A04/MF A01.

This booklet describes how to develop a community-oriented recycling program. It provides information about operations, from the initial steps in developing the program to intermediate operations of the center. It also describes how to effectively plan and organize such a center. The booklet will be useful to Community Action Agencies and other nonprofit organizations in identifying specific markets, materials and procedures necessary to a recycling operation.

EDUCATION AND PUBLIC RELATIONS

19088 (CONF-781235—P1, pp 267-269) **Educating engineers and scientists in industry for energy conservation: the problem-solving approach.** Bock, G.E.; Cohen, K.C. (Massachusetts Inst. of Tech., Cambridge). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

19089 (CONF-781235—P1, pp 271-272) **Project PROCEED: broker of new technologies through continuing education.** Horowitz, M. (Massachusetts Inst. of Tech., Cambridge). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

19090 (CONF-781235—P1, pp 295-297) **Development of an energy technician training program.** Panitz, T. (Cape Cod Community Coll., West Barnstable, MA). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

INTERNAL COMBUSTION ENGINES

19091 (AD-A—074338/5) **Exhaust emissions characteristics for a general aviation light-aircraft Teledyne Continental Motors 6-285-B (Tiara) piston engine. Final report.** Becker, E.E. (National Aviation Facilities Experimental Center, Atlantic City, NJ (USA)). Aug 1979. 99p. NTIS PC A05/MF A01.

The Teledyne Continental Motors 6-285-B engine (S/N700106) was tested at the National Aviation Facilities Experimental Center (NAFEC) to develop an exhaust emissions data base. This data base consists of current production baseline emissions characteristics, lean-out emissions data, effects of leaning-out the fuel schedule on cylinder head temperature, and data showing ambient effects on exhaust emissions and cylinder head temperatures. The engine operating with its current full-rich production fuel schedule could not meet the proposed Environmental Protection Agency (EPA) standard for carbon monoxide (CO) under sea level standard-day conditions. The engine did, however, meet the proposed EPA standards for unburned hydrocarbons (HC) and oxides of nitrogen (NOx) under sea level standard-day conditions. The results of engine testing under different ambient conditions are also presented, and these results show a trend toward higher levels of emissions output for CO and HC under warm-or hot-day conditions while producing slightly lower levels of NOx.

DIESEL

19092 (PB—80-104995) **Evaluation of exhaust collection configuration on diesel particulate measurement. Technical report.** Penninga, T. (Environmental Protection Agency, Ann Arbor, MI (USA)). May 1979. 12p. NTIS, PC A02/MF A01.

On February 1, 1979, the EPA published proposed rules regulating particulate emissions for light-duty diesel vehicles. Questions both internal and external to EPA concerning the practicality and necessity for these requirements resulted in the initiation of a testing program. The test data was run according to the proposed Federal Register requirements for both FTP and HFET cycles. The two test vehicles were a 1975 Mercedes Benz 300D and a 1979 Oldsmobile 350 CID Diesel. Five different configurations of exhaust collection hardware were tested. The two vehicles were tested twice in each configuration. Previous testing programs had established a baseline particulate emission number for each vehicle. All of the individual FTP and HFET tests results are tabulated. The average FTP and HFET results for each configuration were calculated and compared to both the baseline data average, if available, and to the average result of this study. No baseline HFET data was available. In conclusion, there appears to be direct correlation between collection configurations and mass particulate emissions.

EXTERNAL COMBUSTION ENGINES

STIRLING CYCLE

19093 (ANL-K—78-4135-1) **Thermal energy storage for the Stirling engine powered automobile. Final report.** Morgan, D.T. (ed.). (Thermo Electron Engineering Corp., Waltham, MA (USA)). Mar 1979. Contract W-31-109-ENG-38. 323p. (TE—484-66-79; NASA-CR—159561). Dep. NTIS, PC A14/MF A01.

A detailed design of a thermal energy storage (TES) system for use with the Stirling engine as an automotive power system has been developed. The gravimetric and volumetric storage densities are competitive with electric battery storage systems. The TES/Stirling engine system meets all operational requirements for a practical vehicle and can be packaged in compact-sized automobiles with minimum impact on passenger and freight volume. The TES/Stirling system is the only storage approach for direct use of combustion heat from fuel sources not suitable for direct transport and use on the vehicle. The particular concept developed in this study is also useful for a dual-mode TES/liquid fuel system in which the TES (recharged from an external energy source) is used for short-duration trips (~ 10 miles or less) and liquid fuel carried onboard the vehicle used for long-duration trips (as in current automobiles). The dual-mode approach permits an automobile with the convenience and flexibility of current automobiles while offering the potential of 50% savings in the consumption of premium liquid fuels for automotive propulsion in the United States. Relative to the TES-only vehicle, the dual mode approach also reduces the TES cost significantly because of the much smaller TES capacity required.

ELECTRIC-POWERED SYSTEMS

19094 (CONF-781235—P1, pp 105) **Review of automotive transportation possibilities using solar-derived energy selection of candidates for early commercialization.** McAlevy, R.F. III. (Stevens Inst. of Tech., Hoboken, NJ). 1978.

From Symposium on commercialization of solar and conservation technologies; Miami Beach, FL, USA (11 Dec 1978).

19095 (JPL-PUBL—80-13) **Assessment of the potential of hybrid vehicles. Summary. JPL Project 5030-345, Volume I, Rev. A.** Surber, F.T. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Mar 1980. Contract EM-78-I-01-4209. 69p. Dep. NTIS, PC A04/MF A01.

An assessment of the potential of hybrid vehicles as a replacement of the conventional gasoline or diesel fueled internal combustion engine (ICE) vehicle within the next 20 to 30 years is made. In particular, it was determined that there are hybrid vehicle designs and applications which are technically and economically viable and offer reductions in petroleum usage large enough to warrant major expenditures of R and D funds. Critical technical areas where R and D can be most usefully concentrated are identified.

19096 (UCRL—52841(Vol.2)) **Energy storage systems for automobile propulsion: 1979 study. Volume 2. Detailed report.** Forsberg, H.C.; Anderson, C.J.; Behrin, E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Dec 1979. Contract W-7405-ENG-48. 288p. Dep. NTIS, PC A13/MF A01.

The results are given for FY 1979 of a national multilaboratory study of energy-storage propulsion systems for automobiles. The findings of the four participating panels are presented, including a technical and cost update for the energy-storage devices and resultant vehicles. In addition, an evaluation methodology is described for national energy and market impact, a manufacturing and service infrastructure study is introduced, and an examination is made of certain specialty markets. The 1979 study continues to project the energy-storage device characteristics and evaluates the resulting vehicles. The systems analyzed included several that were not considered in the 1978 work, and three that had not been previously evaluated: the short-range but high-performance all-electric vehicle; the hydrogen-fuel-cell-powered electric; and the advanced-battery eV, power boosted with an advanced-design, fiber-composite flywheel.

19097 (UCRL—83662) **Dynamic testing of the Roadway Powered Electric Vehicle (RPEV) System.** Davis, D.D.; Dease, C.W.; Wallace, R.I.; Walter, C.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Feb 1980. Contract W-7405-ENG-48. 17p. (CONF-800523—2). Dep. NTIS, PC A02/MF A01.

From 3. international electric vehicle exposition and conference; St. Louis, MO, USA (May 1980).

Practicality of the Roadway Powered Electric Vehicle (RPEV) System under dynamic operating conditions is being examined. In the RPEV System, energy is electromagnetically coupled without mechanical contact from a powered roadway to electric vehicles. Energy from the roadway can be used for high-speed, long-range travel, and for replenishing energy stored onboard the vehicles. The stored energy is available for shorter range travel on nonpowered surface streets. The dynamic test system at LLL includes a 50 m lane of powered roadway, an ac power source, and an electrically propelled test vehicle equipped with a roadway power pickup, onboard batteries, and instrumentation. The dynamic power coupling system allows up to 16 kW of coupled power. Its design is based on results obtained from static prototype tests. Dynamic tests will examine power coupling capacity, system characteristics, vehicle performance, roadway compatibility, and safety. Descriptions of the dynamic test facility, the status of RPEV component and test system development, dynamic test plans, and results of the static prototype tests previously conducted are presented.

VEHICLE DESIGN FACTORS

19098 (PB—296369) **Applicability of digital data communication features in public transit systems: executive summary.** Datta, T.K.; Bowman, B.L.; Cynecki, M.J. (Wayne State Univ., Detroit, MI (USA). Dept. of Civil Engineering). Sep 1978. 27p. NTIS, PC A03/MF A01.

A survey was conducted of the state of the art of automatic vehicle monitoring (AVM) systems and their use in public transit, taxi, and police operations. The survey identified systems applicable to improving operational efficiency and quality of service, and reviewed various of their elements related to AVM systems. These elements included vehicle location, vehicle identification, vehicle monitoring, computer scheduling, computer dispatch, silent alarms, security alarms, mechanical alarms, on-board readout, real time display, passenger counting, management reporting, and digital data hardware.

19099 (PB—296379) **Applicability of digital data communication features in public transit systems: technology assessment. Final report.** Datta, T.K.; Bowman, B.L.; Cynecki, M.J. (Wayne State Univ., Detroit, MI (USA). Dept. of Civil Engineering). Sep 1978. 156p. NTIS, PC A08/MF A01.

A survey was conducted of the state of the art of automatic vehicle monitoring (AVM) systems and their use in public transit, taxi, and police operations. The systems identified are applicable to improving operational efficiency and quality of service. The various system elements related to AVM systems were reviewed. Those elements included vehicle location, vehicle identification, vehicle monitoring, computer scheduling, computer dispatch, silent alarms, security alarms, mechanical alarms, on-board readout, real-time display, passenger counting, management reporting, and digital data hardware.

ENGINE-TRANSMISSION MATCHING

19100 (COO—4867-6) **Gas turbine engines and transmissions for bus demonstration programs. Technical status report, 31 October 1979-31 January 1980.** Nigro, D.N. (Detroit Diesel Allison, Indianapolis, IN (USA)). Feb 1980. Contract EM-78-C-02-4867. 7p. Dep. NTIS, PC A02/MF A01.

Progress is reported on the procurement and delivery of 11 Allison GT 404-4 Industrial Gas Turbine Engines and 5 HT740CT and 6 V730CT Allison Automatic Transmissions for the Greyhound and Transit Coaches, respectively. Ceramic regenerators have been incorporated in the build configuration for last 4 Transit Coach engines. The 5 Greyhound Coach engines and the first 2 Transit Coach engines were built in the all-metal configuration. The Master Schedules for the program are presented.

WEIGHT

19101 (PB—296224) **Import passenger automobile weight projections 1979-1986: Mercedes-Benz, BMW, Volvo, Bl Ltd. Final report, August-October 1978.** Taylor, T. Jr; Isaacs, M.C.; Blythe, K.E. (Corporate-Tech Planning, Inc., Waltham, MA (USA)). Nov 1978. Contract DOT-HS-7-01789. 161p. NTIS, PC A08/MF A01.

A preliminary analysis is presented for projecting curb weights of automobiles for four import manufacturers -- Mercedes-Benz, BMW, Volvo, BL Ltd. These manufacturers may have difficulties meeting U.S. fuel economy standards for the 1978 through 1985 model year period due to their limited offering of luxury and or sports vehicles with low fuel economy ratings. An overview of their product plans, financial and production status was developed from publicly available sources, highlighting fuel economy efforts. Even with expanded use of diesel engines (development of which is subject to stricter emissions standards) and turbochargers, substantial weight loss would probably be needed to meet legislated goals. An analysis of potential weight reduction through the mid-1980's was performed based on engineering analysis and the manufacturer's known product plans to the extent available. Individual manufacturer's strategies of weight loss due to (1) all new vehicle design, (2) major sheet metal change, and (3) component redesign and material substitution were formulated, drawn in part from weight reduction successes achieved by U.S. manufacturers. Results are presented at the detail level by manufacturer and model and at the summary level by series and EPA market class. Weight loss potentials from eleven to thirty-two percent (depending on vehicle size and engine type) were estimated from 1978-1986.

EMISSION CONTROL

REFER ALSO TO CITATION(S) 19091, 19092

19102 (PB-–294368) **Application for certification for 1979 model year for light-duty vehicles - Renault engine families.** (Renault, Inc., Englewood Cliffs, NJ (USA)). 21 Nov 1978. 870p. Also available in set of 20 reports PC$1460.00, MF$51.00, PB-294 367-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19103 (PB—294369) **Application for certification for 1979 model year for light-duty vehicles - part 1, 1, 11 Saab Scania of America, Inc.** (Saab-Scania of America, Inc., Orange, CT). 21 Nov 1978. 388p. Also available in set of 20 reports PC$1460.00, MF$51.00, PB-294 367-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19104 (PB—294370) **Application for certification for 1979 model year for light-duty vehicles - Jaguar/engine family/Federal B/50, british leyland motors, inc.** (British Leyland Motors, Inc., Leonia, NJ (USA)). 21 Nov 1978. 392p. Also available in set of 20 reports PC$1460.00, MF$51.00, PB-294 367-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19105 (PB—294372) **Application for certification for 1979 model year for light-duty vehicles - General Motors.** (General Motors Proving Ground, Milford, MI (USA)). 21 Nov 1978. 3842p. Also available in set of 20 reports PC$1460.00, MF$51.00.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19106 (PB—294373) **Application for certification for 1979 model year for light-duty vehicles - Jaguar, British Leyland Motors, Inc.** (British Leyland Motors, Inc., Leonia, NJ (USA)). 21 Nov 1978. 1632p. Also available in set of 20 reports PC$1460.00, MF$51.00, PB-294 367-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems an exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed

during testing. The part II application submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19107 (PB—294374) **Application for certification for 1979 model year light-duty vehicles - International Harvester Company.** (International Harvester Co., Melrose Park, IL (USA)). 21 Nov 1978. 643p. Also available in set of 20 reports PC$1460.00, MF$51.00, PB-294 367-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19108 (PB—294375) **Application for certification for 1979 model year for light-duty vehicles - Chrysler Corporation.** (Chrysler Corp., Detroit, MI (USA)). 21 Nov 1978. 2448p. Also available in set of 20 reports PC$1460.00, MF$51.00, PB-294 367-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19109 (PB—294376) **Application for certification for 1979 model year for light-duty vehicles - Mercedes-Benz N.A. Inc.** (Mercedes-Benz of North America, Inc., Montvale, NJ). 21 Nov 1978. 1241p. Also available in set of 20 reports PC$1460.00, MF$51.00, PB-294 367-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19110 (PB—294377) **Application for certification for 1979 model year for light-duty vehicles - Alfa Romeo, Inc.** (Alfa Romeo, Inc., Englewood Cliffs, NJ (USA)). 21 Nov 1978. 562p. Also available in set of 20 reports PC$1460.00, MF$51.00, PB-294 367-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19111 (PB—294378) **Application for certification for 1979 model year for light-duty vehicles - Mitsubishi Motors Corporation.** (Mitsubishi Motors Corp., Tokyo (Japan)). 21 Nov 1978. 1486p. Also available in set of 20 reports PC$1460.00, MF$51.00, PB-294 367-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19112 (PB—294379) **Application for certification for 1979 model year for light-duty vehicles - Porsche.** (Volkswagen of America, Inc., Culver City, CA (USA). Los Angeles Region). 21 Nov 1978. 1592p. Also available in set of 20 reports PC$1460.00, PC$51.00, PB-294 367-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application, submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19113 (PB—294380) **Application for certification for 1979 model year for light-duty vehicles - Audi.** (Volkswagen of America, Inc., Ann Arbor, MI). 21 Nov 1978. 990p. Also available in set of 20 reports PC$1460.00, MF$51.00, PB-294 367-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19114 (PB—294381) **Application for certification for 1979 model year for light-duty vehicles - Volkswagen.** (Volkswagen of America, Inc., Ann Arbor, MI). 21 Nov 1978. 1884p. Also available in set of 20 reports PC$1460.00, MF$51.00, PB-294 367-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application submitted after emission testing is completed, contains the results of emission testing a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19115 (PB—294382) **Application for certification for 1979 model year for light-duty vehicles - American Motors Corporation.** (American Motors Corp., Detroit, MI). 21 Nov 1978. 1448p. Also available in set of 20 reports PC$1460.00, MF$51.00, PB-294 367-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model

year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19116 (PB—294383) **Application for certification for 1979 model year for light-duty vehicles - Toyota Motor Co.** (Toyota Motor Sales, U.S.A., Inc., Lyndhurst, NJ). Dec 1978. 1789p. Also available in set of 20 reports PC$1460.00, MF$51.00, PB-294 367-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application, submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19117 (PB—294384) **Application for certification for 1979 model year for light-duty vehicles - Rolls-Royce.** (Rolls Royce, Inc., Paramus, NJ (USA)). 30 Mar 1979. 485p. Also available in set of 20 Reports PC$1460.00, MF$51.00, PB-294 367-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application, submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19118 (PB—294385) **Application for certification for 1979 model year for light-duty vehicles - Honda.** (American Honda Motor Co., Inc., Gardena, CA). 30 Mar 1979. 817p. Also available in set of 20 reports PC$1460.00, MF$51.00, PB-294 367-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application, submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19119 (PB—294386) **Application for certification for 1979 model year for light-duty vehicles - Peugeot.** (Peugeot Motors of America, Inc., Lyndhurst, NJ). 30 Mar 1979. 876p. Also available in set of 20 reports PC$1460.00, MF$51.00, PB-294 367-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application, submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19120 (PB—294387) **Application for certification for 1979 model year for light-duty vehicles motorcycles - Suzuki Motor Company.** (Suzuki Motor Co. Ltd., Shizuoka (Japan)). 30 Mar 1979. 337p. Also available in set of 20 reports PC$1460.00, MF$51.00, PB-294 367-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application, submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19121 (PB—294389) **Application for certification for 1979 model year for heavy-duty vehicles - General Motors.** (General Motors Proving Ground, Milford, MI (USA)). 21 Nov 1978. 372p. Also available in set of 7 reports PC$250.00, MF$12.00, PB-294 388-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems an exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19122 (PB—294391) **Application for certification for 1979 model year for heavy-duty vehicles - Chrysler Corporation.** (Chrysler Corp., Detroit, MI (USA)). 21 Nov 1978. 288p. Also available in set of 7 reports PC$250.00, MF$12.00, PB-294 388-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19123 (PB—294392) **Application for certification for 1979 model year for heavy-duty engines - International Harvester.** (International Harvester Co., Fort Wayne, IN (USA). Truck Engineering Center). 30 Mar 1979. 979p. Also available in set of 7 reports PC$250.00, MF$12.00, PB-294 388-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and propose maintenance requirements to be followed during testing. The part II application, submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19124 (PB—294393) **Application for certification for 1979 model year for heavy-duty engines - General Motors Co.** (General Motors Technical Center, Warren, MI (USA)). 30 Mar 1979. 433p. Also available in set of 7 reports PC$250.00, MF$12.00, PB-294 388-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application, submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19125 (PB—294394) **Application for certification for 1979 model year for heavy-duty engines - Iveco Trucks Company.** (IVECO Trucks of North America, Inc., Blue Bell, PA (USA)). 30 Mar 1979. 399p. Also available in set of 7 reports PC$250.00, MF$12.00, PB-294 388-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application, submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

19126 (PB—294395) **Application for certification for 1979 model year for heavy-duty engines - Mack Trucks, Inc.** (Mack Trucks, Inc., Hagerstown, MD (USA)). 30 Mar 1979. 1072p. Also available in set of 7 reports, PC$250.00, MF$12.00, PB-294 388-SET.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and propose maintenance requirements to be followed during testing. The part II application, submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

ALTERNATIVE FUELS

19127 (NP—24342) **Investigation of the behavior of methanol as an engine fuel. Research report No. 45151.** (Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg (Germany, F.R.)). 1979. 111p. (In German). Dep. NTIS (US Sales Only), A06/MF A01.

In principle, methanol may be used as a substitute fuel and as mixing component for the dilution of Otto engine fuels. Its use has advantages and disadvantages in all fields, from supply to utilization. If methanol is to be used for the operation of Otto engines, vehicles must be adapted, and the supply system must be modified. For methanol/fuel mixtures, solutions to the important problem of demixing must be found. The study starts out from the assumption that methanolis available in Germany in sufficient quantities, and that supply is ensured everywhere in the country.

MATERIALS

REFER ALSO TO CITATION(S) 18304

19128 **Molten salts: energy research and data center activities.** Janz, G.J. (Rensselaer Polytechnic Inst., Troy, NY). pp 383-388 of Proceedings of the fifth biennial international CODATA conference. Dreyfus, B. (ed.). Elmsford, NY; Pergamon Press Inc. (1977).

From 5. CODATA conference; Boulder, CO, USA (28 Jun 1976).

The Molten Salts Data Center at RPI is discussed, including the contributors and some of the uses made of the data in energy research, thermal energy storage, solar energy utilization, nuclear fusion, and advanced batteries. (FS)

METALS AND ALLOYS

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 18867, 19275

19129 (CONF-791127—, pp 160-166) **Evaluation of laser welding techniques for hydrogen transmission.** Mucci, J.; Harris, J.A. (Pratt and Whitney Aircraft Group, West Palm Beach, FL). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

This program was established to determine the feasibility of laser beam welding as a fabrication method for hydrogen transmission and is a precursor in the effort to systematically provide the technological base necessary for large-scale, economic pipeline transmission of fuel for a hydrogen energy system. The study contributes to the technology base by establishing the sensitivity of two classes of steels to gaseous hydrogen environment effects and determining the effect of conventional weld processes and laser beam welding on properties. Screening evaluation of the tensile, low-cycle fatigue and fracture toughness properties and metallurgical analyses provide the basis for concluding that laser beam welding of AISI 304L stainless steel and ASTM A106B carbon steel can produce weldments of comparable quality to those produced by gas-tungsten arc and electron beam welding and is at least equally compatible with 13.8 MPa (2000 psig) gaseous hydrogen environment.

19130 (DOE/ET/15423—2) **Application of microfabrication technology to thermionic energy conversion. Progress report 2.** Brodie, I.; Gates, D.C. (SRI International, Menlo Park, CA (USA)). 10 Mar 1980. Contract AC02-79ET15423. 12p. Dep. NTIS, PC A02/MF A01.

Two diode designs are being studied that require basically different fabrication techniques. The fabrication of electrodes was begun to test the concepts and the feasibility of these designs. This work was done with polished molybdenum electrode surfaces and vapor-deposited alumina insulator structures. Initial results were obtained in the close spacing of molybdenum electrodes with alumina insulators. Spacings were demonstrated with 1/2-inch diameter discs in the range of 3 to 5 μm, using 1-μm thick insulators. The deposition of thin alumina films on a molybdenum substrate was demonstrated, upon which arrays of thin film electrodes about 1/32-inch in diameter were deposited. A second approach uses a thin film as one of the electrodes. An analysis of the thermal and electrical transport properties of 1-μm thick tungsten film shows that edge-connected films about 1 mm square in area could withstand the stresses generated by differential thermal expansion when the film is attached to the opposite electrode by stand-off insulators.

19131 **Mechanical properties of Inconel 625 welds in 21-6-9 stainless steel at 4°K.** Vandervoort, R.R. (Univ. of California, Livermore). *Cryogenics;* 448-452(Aug 1979).

Tensile and fracture properties of 21-6-9 austenitic stainless steel welded with Inconel 625 were determined at 4°K. Welds were made by the shielded metal-arc, gas tungsten-arc, and gas metal-arc processes. Results from this study showed that base metal, the heat-affected-zone, and all three types of weld metal had good strength, ductility, and toughness at low temperatures.

19132 (SAND—79-8069) **Plating on some difficult-to-plate metals and alloys.** Dini, J.W.; Johnson, H.R. (Sandia Labs., Livermore, CA (USA)). Feb 1980. Contract EY-76-C-04-0789. 25p. Dep. NTIS, PC A02/MF A01.

Electrodeposition of coatings on metals such as beryllium, beryllium-copper, Kovar, lead, magnesium, thorium, titanium, tungsten, uranium, zirconium, and their alloys can be problematic. This is due in most cases to a natural oxide surface film that readily reforms after being removed. The procedures we recommend for plating on these metals rely on replacing the oxide film with a displacement coating, or etching to allow mechanical keying between the substrate and plated deposit. The effectiveness of the procedures is demonstrated by interface bond strengths found in ring-shear and conical-head tensile tests.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 18905, 19131, 19137, 19139, 19140, 19146

19133 (RFP-Trans—280) **Heats of formation of intermetallic compounds of plutonium with gallium and tin. [Paper IAEA-SM-98/52].** Akhachinskii, V.V.; Kopytin, L.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). [nd]. Translated from STI/PUB—162, 1968. 7p. Dep. NTIS, PC A02/MF A01.

From the heats of dissolution in HCl, the heats of formation of the following compounds in the Pu-Ga and Pu-Sn systems at 298°K were determined: Pu_3Ga, 39.5 +- 2.0; $PuGa_2$, 45.4 +- 2.5; $PuGa_6$, 56.9 +- 3.1; Pu_5Ga_3, 100 +- 10; PuGa, 28 +- 3; $PuGa_3$, 56 +- 6; $PuGa_4$, 56 +- 6; and $PuSn_3$, 52.5 +- 0.9 kcal/mole. 3 tables. (DLC)

19134 (CRN-CNPA—78-8) **New techniques used to realize silicon photocells.** Siffert, P. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1978. 99p. (In French). Dep. NTIS (US Sales Only), PC A06/MF A01.

The techniques used to realize the terrestrial silicon solar cells being considered the possible improvements of these methods are discussed. The various approaches under development to prepare silicon sheets in a continuous way are considered for both self-supporting or substrate deposited layers. Finally, the various methods used or under investigation to obtain the surface potential barrier are considered; MIS, heterojunction and ion implantation.

19135 (SAND—80-0041C) **Pressure studies of the Fermi surfaces of α-U and UGe_3.** Schirber, J.E.; Arko, A.J. (Sandia Labs., Albuquerque, NM (USA); Argonne National Lab., IL (USA)). 1980. Contract EY-76-C-04-0789. 12p. (CONF-800417—1). Dep. NTIS, PC A02/MF A01.

From European Physicists Society and Swiss National Science Foundation conference; Zurich, Switzerland (9 Apr 1980).

Measurements of the effect of pressure on four cross sections arising from open sheets of the Fermi surface of α-U have been obtained at pressure ≧ 8 kbar generated in solid He. Also presented are preliminary values for the pressure dependence of two cross sections of the Fermi surface of UGe_3.

19136 **Effect of impurity interstitials on the lattice resistance to dislocation motion.** Arsenault, R.J.; Cadman, T.W. (Univ. of Maryland, College Park). *Metall. Trans., A;* **11**: No. 1, 127-134(Jan 1980).

A computer simulation model was developed to determine the nature of the synergistic effect between the lattice resistance and impurity interstitial atoms to dislocation motion. If the interaction between an impurity interstitial and a screw dislocation in a bcc lattice with a large Peierls barrier is treated in an elastic continuum manner, strengthening will occur. This strengthening occurs at all interstitial concentrations and at all temperatures in the low-temperature region.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 18517, 18862, 18867, 19131, 19147

19137 (COO—2975-37) **Advanced Gas-Cooled Nuclear Reactor Materials Evaluation and Development Program. Progress report, July 1, 1979-September 30, 1979.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). 7 Mar 1980. Contract EY-76-C-02-2975. 52p. Dep. NTIS, PC A04/MF A01.

The results of work performed from July 1, 1979 through September 30, 1979 on the Advanced Gas-Cooled Nuclear Reactor Materials Evaluation and Development Program are presented. The objectives of this program are to evaluate candidate alloys for Very High Temperature Reactor (VHTR) Nuclear Process Heat (NPH) and Direct Cycle Helium Turbine (DCHT) applications, in terms of the effect of simulated reactor primary coolant (helium containing small amounts of various other gases), high temperatures, and long time exposures, on the mechanical properties and structural and surface stability of selected candidate alloys. A second objective is to select and recommend materials for future test facilities and more extensive qualification programs. Work covered in this report includes the activities associated with the status of the simulated reactor helium supply system, testing equipment, and gas chemistry analysis instrumentation and equipment. The status of the data management system is presented. In addition, the progress in the screening test program is described.

19138 (COO—4385-4) **Pore shrinkage and Ostwald Ripening in metallic systems. Progress report, July 1, 1979-June 30, 1980.** Kuczynski, G.C.; Allen, C.W. (Notre Dame Univ., IN (USA)). Mar 1980. Contract EG-77-S-02-4385. 15p. Dep. NTIS, PC A02/MF A01.

The development and testing of a new theory of coarsening phenomena in relation to the classical theory were studied including a preliminary attempt to program the general theory for numerical solution of particular cases. Size distribution analyses of Ni_3Al in Ni rich matrix, analyses of void distributions under near equilibrium conditions, and an investigation of size distribution for discrete porosity in nickel are reported. (FS)

19139 **Structure of deformed silicon and implications for low-cost solar cells.** Mardesich, N. (Spectrolab, Sylmar, CA); Leipold, M.H.; Turner, G.B.; Digges, T.G. Jr. *Metall. Trans., A;* **10**: No. 12, 1831-1835(Dec 1979).

The microstructure and minority carrier lifetime of silicon were investigated in uniaxially compressed silicon samples. The objective of the investigation was to determine if it is feasible to produce silicon solar cells from sheet formed by high temperature deformation. The initial structure of the silicon samples ranged from single crystal to fine grained polycrystals. The samples had been deformed at strain-rates of 0.1 to 8.5 s^{-1} and temperatures of 1270 to 1380°C. Recrystalliztion was incomplete even after long anneals. A 10 h anneal of fine grained samples with as much as 51 pct strain only caused 95 pct of the samples to recrystallize and even then the recrystallized grains contained twin boundaries and dislocations. The recrystallization in the large grained material was also incomplete and further, it has been shown that large grained material cracks readily during significant deformation (>40 pct). The major mode of recrystallization appears to be migration of existing boundaries into the deformed regions. Minority carrier diffusion length was found to be drastically reduced after deformation, perhaps due to contamination or cooling rate, and recovered only slightly with annealing. These results suggest that high temperature deformation of silicon to directly produce sheet for solar cells of high efficiency is not practical. Potential may exist for its use as a coarse grained substrate.

19140 **Analysis of cavity growth during superplasticity.** Miller, D.A. (Univ. of Bristol, England); Langdon, T.G. Contract DE-AS03-76SF00113; PA-DE-AT03-76ER10408. *Metall. Trans., A;* **10**: No. 12, 1869-1874(Dec 1979).

Cavity growth at high temperature may be controlled by vacancy diffusion, giving cavities which are approximately spherical and randomly distributed, or by power-law creep, giving cavities which are elongated and aligned in the direction of the tensile stress. In general, diffusion growth is favored at low total strains, and there is a transition to power-law growth at a critical cavity radius, γ/sub c/. The value of γ/sub c/ increases with decreasing strain-rate, so that there is also a transition from predominantly power-law growth at high stress levels to predominantly diffusion growth at low stress levels. Both types of cavities have been observed in superplastic materials, but the diffusion growth rate may be enhanced if the cavity intersects a number of grain boundaries. The analysis is in good agreement with experimental results reported for three different superplastic materials.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 19804, 19808, 19871, 19873

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 18508, 18509, 18510, 18512, 18513, 18518, 18519, 18520, 19137, 19723

19141 (CONF-791127—, pp 129-131) **Corrosion testing of materials in hot concentrated sulfuric acid.** Krikorian, O.H. (Univ. of California, Livermore). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

We are testing and evaluating materials for a sulfuric acid boiler for use in thermochemical hydrogen cycles that require decomposition of H_2SO_4. Operating conditions call for boiling of 97 wt % H_2SO_4 at ~ 673K and 1 MPa pressure. We have determined that high silicon content materials can generally tolerate the corrosive conditions that prevail. Materials that appear most suitable at present, especially as heat exchanger materials, are Durichlor-51 and SiC. Preliminary tests on $CrSi_2$-coated Incoloy 800 also show good promise.

19142 (CONF-791127—, pp 155-159) **Influence of ferrous microstructure on the fatigue crack growth rate in air and in hydrogen.** Wachob, H.F. (NASA-Ames Research Center, Moffett Field, CA). Feb 1980.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

An improvement in the fatigue crack growth resistance of a commercial low strength steel in air and high pressure hydrogen may be possible by the proper selection of microstructure. Various ferrous microstructures - tempered martensite, austempered bainite, and normalized pearlite - were produced by standard heat treatments of an A516-G70 carbon steel. The near-threshold, fatigue crack growth rate was measured as a function of microstructure, environment, R ratio (P/sub min//P/sub max/, and alternating stress intensity. Results are presented which indicate that increased amounts of free ferrite and pearlite increase the crack growth rates and decrease the fatigue threshold stress intensity. Additionally, these observations are supported by fractographic and metallographic correlations.

19143 (DOE/ER/02421—6) **Corrosion, stress corrosion cracking, and electrochemistry of the iron and nickel base alloys in caustic environments.** Koehler, R.; Beck, F.H.; Agrawal, A.K.; Soendjasmono, B.; Staehle, R.W. (Ohio State Univ., Columbus (USA). Dept. of Metallurgical Engineering). Feb 1980. Contract AS02-76ER02421. 56p. Dep. NTIS, PC A04/MF A01.

The electrochemical behavior of high purity (99.95% to 99.99%) iron in 0.6M NaCl and 1.0M Na_2SO_4 containing H_2S (50 ppM to 34,000 ppM) was studied using cyclic voltammetry, chronoamperometry, and slow scan rate polarization. Results have indicated that iron does undergo passivation in sulfate solutions containing H_2S. Iron dissolution depends on the presence of Cl^-, the concentration of H_2S and solution pH. An equation is given that describes the anodic Tafel current densities. The slow strain rate test was used to evaluate the effect of electrode potential on the susceptibility of 2-1/4Cr, Mo steel to stress corrosion cracking in boiling 50% NaOH solution. Susceptibility decreased and general corrosion increased with increasing potentials. Failures contained a combination of ductile and brittle fracture. Time-to-failure was longest for controlled potentials of -700 and -600mV (Hg/HgO reference) in the -1100 to -400mV range used in this study.

19144 **Effect of segregated sulfur on the stress corrosion susceptibility of nickel.** Chaung, H.; (Exxon Production Research Co., Houston, TX); Lumsden, J.B.; Staehle, R.W. *Metall. Trans., A;* **10**: No. 12, 1853-1857(Dec 1979).

Auger electron spectroscopy has been used to investigate surface segregation on nickel single crystals and grain boundary segregation in Ni 200. Sulfur was found to be the main segregating species in the temperature range 550 to 850°C. Segregated sulfur was shown to catalyze the anodic dissolution kinetics when nickel is exposed to sulfuric acid. Its presence in the grain boundaries of Ni 200 causes susceptibility to IGSCC.

19145 **Materials behavior in hydrogen-fluorine environments.** Holcombe, C.E.; Weber, G.W.; Kovach, L. (Union Carbide Corp., Oak Ridge, TN). *Am. Ceram. Soc. Bull.;* **58**: No. 12, 1185-1188, 1192(Dec 1979).

From 80. annual meeting of the American Ceramic Society; Detroit, MI, USA (8 May 1978).

An investigation of the behavior of 32 different compounds, solid solutions, and elements in a controlled temperature $2F_2/1H_2$ flame is reported. Stability is determined by the properties of the fluoride that forms on the exposed surface of the material. Materials with volatile fluorides are unprotected, whereas fluoride-film formers exhibit near-zero corrosion below the film failure temperature, T/sub f/. The T/sub f/ depends on the melting, vaporizing, and mechanical characteristics of the film. A ranking of fluoride-film formers with maximum use temperatures for near-zero corrosion in the range 1800 to 1400°K is $LaB_6 > CaB_6 > La_2O_3$ $Si_3N_4 >$ (Sc,SrO,$LaCrO_3$,Ni).

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 18862, 19873

19146 (COO—3158-87) **Defects in metal crystals. Progress report, May 1, 1979-April 30, 1980.** Seidman, D.N. (Cornell Univ., Ithaca, NY (USA)). Jan 1980. Contract AC02-76ER03158. 116p. Dep. NTIS, PC A06/MF A01.

A broad investigation of the properties of crystal defects in metals and semiconductors was made. Attention during the past year has focused on fundamental properties of point defects (vacancies and self-interstitial atoms); aggregates of point defects (i.e., depleted zones); the range profiles of low-energy (< 1000 eV) implanted ^4He and ^1H in tungsten, the diffusive properties of ^4He and ^1H; the adsorption kinetics and sticking coefficient of hydrogen on tungsten; the imaging of silicon by field-ion microscopy; the chemical analysis of ordered Ni_4Mo and GaAs - on an atomic scale - via atom-probe field microscopy; and the low-temperature isochronal recovery behavior of ion-irradiated Ni_4Mo and Pt_3Co. Heavy use was made of the high-resolution field-ion microscope and the atom-probe field-ion microscope.

19147 (HEDL-SA—1937) **HVEM in-situ deformation of neutron irradiated Fe-0.3a/oCu.** Gelles, D.S.; Thomas, L.E.; Powell, R.W. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1980. Contract EY-76-C-14-2170. 14p. (CONF-800205—6). Dep. NTIS, PC A02/MF A01.

From American Institute of Metallurgical Engineers meeting; Las Vegas, NV, USA (Feb 1980).

In an effort to better understand the nature of irradiation embrittlement of low alloy steels, in-situ HVEM deformation tests have been performed on pure iron and iron-0.3% copper ribbon tensile specimens in both the unirradiated and irradiated (2.5×10^{19} n/cm^2, E > 1 MeV at 290°C) conditions. Microstructural response is described principally in terms of the matrix in which cracks were observed to propagate across the different specimens. Major differences between the irradiation iron-copper alloy and the other material conditions were (1) the plastic zone which developed ahead to propagating cracks was smaller, and (2) dislocations were found to develop a crenulated structure uncharacteristic of the other conditions studied. It is inferred that the crenulations result from the presence of obstacles to dislocation motion and thereby demonstrate the matrix strengthening effect of small, radiation-induced, presumably copper-rich precipitates. However, the obstacles which are most effective in retarding dislocation motion are found to be distributed on a much coarser scale than that of the radiation-induced loops.

CERAMICS, CERMETS, AND REFRACTORIES

REFER ALSO TO CITATION(S) 18826, 19215

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 18443

19148 **Sintering of Si_3N_4.15Y_2O_3 under high N_2 pressure.** Galasso, F.; Veltri, R. (United Technologies Research Center, East Hartford, CT). *Am. Ceram. Soc. Bull.;* **58**: No. 8, 793-794(Aug 1979).

In the present study, pressureless sintering was conducted to determine if the same advantages could be obtained when Si_3N_4.15Y_2O_3 pellets under high N_2 pressure. This system was of interest because excellent ambient and high temperature properties had previously been obtained with hot-pressed samples. Some $Si_3Y_2O_3N_4$ (reported to be poor in oxidation resistance at 1000°C) was present in the high density pellets, oxidation studies on these pellets at 1000°C did not indicate any catastrophic oxidation behavior. At 1350°C in air, the high density samples showed good oxidation resistance, with the rate of weight gain for the pellets decreasing with increasing density of the sample.

19149 **Hot pressing spinel hemishells with retractable tooling.** Sheinberg, H. (Los Alamos Scientific Lab., NM). *Am. Ceram. Soc. Bull.;* **58**: No. 7, 719, 721(Jul 1979).

A 254-mm-OD spinel (Mg Al_2O_4) hemishell with varying wall thickness and a density of 3.2 to 3.3 Mg/m^3 was produced by a retractable tooling/graphite-die assembly. A 307-mm-OD hollow spinel hemishell with a wall thickness of 35 mm was also made by the same technique. (FS)

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 19157

19150 (DOE/ER/10428—1) **Protective oxide films. Progress report, August 1979-February 1980.** MacCrone, R.K.; Shatynski, S.R. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Materials Engineering). 1980. Contract AC02-79ER10428. 10p. Dep. NTIS, PC A02/MF A01.

The progress made during the period from initiation of the grant August 1979 to the present time February 1980 is described. This includes a description of (1) the construction of a thermogravimetric facility, (2) the growth and characterization of CVD single crystal NiO films, (3) I versus V measurements at different temperatures, (4) I versus t curves at different voltages.

19151 (IS-M—272) **Deuterium superlattice formation in lanthanum trideuterides: the NMR evidence.** De Groot, D.G.; Barnes, R.G.; Beaudry, B.J.; Torgeson, D.R. (Ames Lab., IA (USA); Iowa State Univ. of Science and Technology, Ames (USA); Vrije Univ., Amsterdam (Netherlands)). 1980. Contract W-7405-ENG-82. 19p. (CONF-800402—9). Dep. NTIS, PC A02/MF A01.

From International symposium on the properties and applications of metal hydrides; Colorado Springs, CO, USA (7 Apr 1980).

The results are reported of the first deuterium magnetic resonance (DMR) investigation of lanthanum tri-deuterides, LaD/sub x/, ($2.28 \leqq x \leqq 3.00$). The DMR spectra distinguish three different crystalline electric field (CEF) environments of deuterium as follows: (a) octahedral (0)-sites which retain nearly cubic symmetry, (b) axially symmetric tetrahedral (T) and O-sites, and (c) strongly asymmetric T-sites resulting from a pair of occupied neighboring 0-sites. The observed relative strengths and symmetries of these CEF's are consistent with the deuterium superlattice structure based on neutron diffraction measurements. Since no quadrupole splitting occurs at 300°K, rapid deuterium motion must occur along all T and O sites. The on-set of quadrupole splitting for $2.28 \leqq x \leqq 2.62$ occurs sharply in the range 240 to 250°K in which heat capacity and DTA measurements revealed anomalies. Sites (a) and (b) predominate at $x = 2.28$ and (b) and (c) at $x = 2.48$ and 2.62. At $x = 2.78$ rapid deuterium motion persists to still lower temperatures, the on-set of quadrupole splitting (site c) being at 180 to 190°K. For $2.90 \leqq x \leqq 3.00$, no quadrupole splitting is detected at temperatures as low

as 120°K, indicating that tetragonal (or other) distortion of the f.c.c. lanthanum lattice does not occur.

19152 Crystallography of hydride formation in zirconium. II. The $\delta \rightarrow \epsilon$ transformation. Cassidy, M.P. (Western Electric Engineering Research Center, Princeton, NJ); Wayman, C.M. *Metall. Trans., A;* **11**: No. 1, 57-67(Jan 1980).

The phenomenological crystallographic theory of martensitic transformations has been applied to the transformation from δ (fcc) to ϵ (fct) zirconium hydride, using published lattice parameters. The habit plane, orientation relationship, lattice invariant shear, and interface characteristics were determined by transmission electron microscopy and diffraction. The shape strain was observed by interference microscopy. Good agreement between the predictions of the theory and the measured crystallography was obtained. The predicted and observed lattice invariant shear was twinning on [101]. These twins which are found within alternating bands of hydride variants produce a herringbone morphology, and the bands produce a roof gable type of surface relief. For a given plate, the measured habit plane, twin plane, unique Bain contraction axis, and orientation relationship were mutually consistent with the respective predictions for a single variant. The magnitude of the lattice invariant shear was in excellent agreement with the predicted value. The interfaces separating the ϵ hydride bands were found to be of two types, which alternated, often filling an entire grain. One of these, termed a spear interface, was found to be a twin plane, across which the twinned regions of the two bands matched-up. The other, termed an impingement interface, was found to have twin regions which did not match up.This morphology can be explained as a pair of ϵ-hydride plates which share a spear interface. When two growing spears impinge, the resulting impingement interface is of the second type.

19153 (SAND—79-6007) **Process for the preparation of wurtzite-like boron nitride, and wurtzite-like boron nitride.** 11 Dec 1979. Translation of . German(FRG) Patent 2,219,394. 34p. Dep. NTIS, PC A03/MF A01.

The amount of wurtzite-like BN in the shock wave synthesis can be increased by the following method: the graphite-like BN is mixed with additives of differing dynamic hardness, and with a residual temperature lying below that of wurtzite-like BN. The additive (preferable water or aqueous alkali salt solution) increases the multiple reflection of the shock waves within the BN, thus increasing the conversion to the wurtzite form. (DLC)

19154 Microstructure and ionic resistivity of calcium-containing sodium beta alumina. Buechele, A.C.; De Jonghe, L.C. (Univ. of California, Berkeley). *Am. Ceram. Soc. Bull.;* **58**: No. 9, 861-864(Sep 1979).

Calcium-containing sodium beta aluminas were prepared, and their microstructure and ionic resistivity were studied. The calcium significantly promotes abnormal grain growth at temperatures above 1700°C and leads to the formation of highly blocking intergranular calcium aluminate phases. Evidence was also found for partial solution of calcia in β-alumina. The dc resistivity, rho, at 300°C was found to increase exponentially with calcium content [C], leading to a relation of the type: $\log (\rho/\rho_0) = B[C]$, where the proportionality factor B depends on the sintering conditions.

19155 Characterization of pollucite as a material for long-term storage of cesium-137. Strachan, D.M.; Schulz, W.W. (Rockwell Hanford Operations, Richland, WA). *Am. Ceram. Soc. Bull.;* **58**: No. 9, 865-868(Sep 1979).

From 30. Pacific Coast regional meeting of the Amercian Ceramic Society; Los Angeles, CA, USA (1 Nov 1977).

Pollucite ($Cs_2O.Al_2O_3.4SiO_2$) may be an acceptable material for the long-term storage of purified $^{137}CsCl$. Pollucite is made at near theoretical yields when CsCl (or any cesium salt) reacts at $\approx$ 970°K with a montmorillonite-containing clay. Pollucite dissolves in deionized water at rates $< 2 \times 10^{-7}$ kg/(m^2 d) based on cesium. Microstructural analyses showed that cesium reacts with montmorillonite clay to form ill-defined pollucite crystals containing low concentrations of the impurities found in the clay. Although further work needs to be done, pollucite is considered to be an excellent materials for the long-term storage of ^{137}Cs.

MECHANICAL PROPERTIES

19156 Determination of the elastic moduli of a directionally solidified nickel-based TaC eutectic. Fisher, E.S. (Argonne National Lab., IL). *Metall. Trans., A;* **11**: No. 1, 103-109(Jan 1980).

Measurements of ultrasonic wave velocities in a polycrystalline directionally solidified nickel based eutectic alloy are used to evaluate the three independent single crystal elastic moduli at temperatures between 298 to 925°K. The C_{11} and C_{44} moduli are obtained directly from high frequency wave propagation along the D.S. axis, corresponding to <100>. Evaluation of C_{12} requires measurements at lower frequencies to obtain (C_{11}-E/sub <100>/). The elastic anisotropy and temperature dependence of the elastic moduli are almost identical to those reported for pure Ni, indicating that neither TaC fiber reinforcement nor γ' precipitate have strong effects on elastic properties of Ni based turbine blade alloys.

19157 Ceramic processing: a ceramic science. Pask, J.A. (Univ. of California, Berkeley). *Am. Ceram. Soc. Bull.;* **58**: No. 12, 1163-1166(Dec 1979).

From 81. annual meeting of the American Ceramic Society; Cincinnati, OH, USA (1979 Apr 30).

Ceramic materials are of great interest for energy programs because of their mechanical properties at high temperature, and their capability to withstand high temperature hostile environments. An understanding is needed for the effect of small amounts of impurities. A chart is given which shows the interrelation of fabrication or processing/materials response/character/properties. (FS)

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 19154, 19155

19158 (COO—4946-2) **Studies of metal: semiconductor interfaces in catalysis and energy conversion. Annual report, June 15, 1979-June 14, 1980.** Chung, Y.W. (Northwestern Univ., Evanston, IL (USA)). Mar 1980. Contract ER-78-S-02-4946. 27p. Dep. NTIS, PC A03/MF A01.

Experimental capabilities were enhanced by the incorporation of an Al/Mg Kα x-ray source for x-ray photoemission studies, a micro-computer for data acquisition and analysis, an isolation cell attachment to the UHV surface analysis chamber for performing high pressure chemical reaction studies, a high intensity UV light source for photochemical studies, and finally an ultra-sensitive quartz crystal thickness monitor for controlled metal deposition. A method was developed to measure the chemical state of ad-atoms on semiconductor surfaces using x-ray photoemission. Using such a technique, it was found that the Pt atoms in contact with the $SrTiO_3$ (100)-(1x1) surface acquire a negative charge, viz 0.6 electron/Pt-atom. By studying the line shape changes of the Ti 2p core levels, it was found that the charge transfer is via the Ti^{3+} -oxygen vacancy complexes on the $SrTiO_3$ surface.

19159 Heating of uranium oxides in a microwave oven. Haas, P.A. (Oak Ridge National Lab., TN). *Am. Ceram. Soc. Bull.;* **58**: No. 9, 873(Sep 1979).

The original objective of the tests was to dry samples of hydrated UO_3 gel spheres as part of a nuclear fuel preparation process. When exposed to microwave energy a hot spot will develop and grow until a 1- to 3-cm-diameter area is glowing brightly. This glowing area would reach a steady-state size without any change in the remaining UO_3. Additional tests have shown that the coupling with the microwave energy appears to require reduced valences of uranium. Several different samples of dry UO_3 did not show any significant heating when exposed in the microwave oven. On the other hand, all of the UO_2 and U_3O_8 samples heated strongly. Apparently, the hydrated gel samples first tested underwent small amounts of reduction from traces of NH_3 and organic materials remaining in the gel after washing. Once overheating started, hexavalent uranium was converted to U_3O_8 until all the microwave energy was being transformed into heat and radiated at a steady-state temperature.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 19145, 19148

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 18853

COMPOSITE MATERIALS

19160 (GEPP-TIS—480) **Laboratory systems automation using the general purpose interface bus.** Beetley, D.E. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 7 Apr 1980. Contract EY-76-C-04-0656. 11p. Dep. NTIS, PC A02/MF A01.

Presented is an implementation of the General Purpose Interface Bus, or GPIB, for use in a system control application. The Signetics HEF 4738 Bus Interface Adapter provides the necessary bus timing and CMOS logic is used for high noise immunity. The design will allow up to 31 devices to be interfaced. A rotary table position control illustrates the use of the interface. This application allows control of table location as well as direction and rate of travel. The destination angle can also be read to verify table location. The read/write board used in this application can transfer up to 16 BCD or binary bytes of data.

POLYMERS AND PLASTICS

19161 (SAND—80-6002) **Study of the modification of sole rubbers with products of the mechanical dispersion of kapron.** Komissarov, S.A.; Baramboim, N.K.; Safrai, B.A.; Dinzberg, B.N. Translated from *Izv. Vyssh. Uchebn. Zaved., Tekhnol. Legk. Prom-sti.;* No. 1, 46-49(1969). 8p. Dep. NTIS, PC A02/MF A01.

When kapron is mechanically degraded, complex physicochemical changes reflected in the geometric dimensions of the particles, molecular weight, IR spectra, solubility, and sorption characteristics take place. Fibrous PA filler enables us to obtain rubbers with improved overall properties, its effectiveness being determined chiefly by the duration of the mechanical dispersion.

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 18573

STRUCTURE AND PHASE STUDIES

19162 (SAND—80-6000) **Demixing problems in polymers.** Joanny, J.F. (Paris-6 Univ., 75 (France)). Nov 1979. Translation of Third cycle doctoral thesis in physics, Universite Pierre et Marie Curie, Paris VI, October 23, 1978. 108p. Dep. NTIS, PC A06/MF A01.

Phase transitions in polymers were studied in four chapters: Flory-Huggins theory and experiment, critical demixing properties, effects of polydispersion, and two-dimensional systems. (DLC)

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 18573

19163 (SAND—79-1356C) **Flexural response of Kevlar/epoxy composite beams adhesively bonded at the mid-plane.** Guess, T.R.; Allred, R.E. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 54p. (CONF-800518—1). Dep. NTIS, PC A04/MF A01.

From 25. national SAMPE symposium; San Diego, CA, USA (6 May 1980).

The results of an analytical and experimental study to determine the effect of a thin adhesive interlayer on the flexural stiffness and strength of warp-aligned Kelvar 49 Style 143 fabrix/5208 epoxy composite beams are reported. Layered and sold composite laminate constructions 12.5 mm thick were analyzed by finite element techniques. The layered construction consisted of two 6.25 mm thick laminates bonded together with a 0.076 - 0.229 mm adhesive bond. Bend test runs at 22°C verified that the layered and solid beams have essentially identical stiffness and strength. Changes indicate the temperature depends on the composite. (FS)

19164 (SAND—80-6001) **Use of synthetic fiber fillers in rubber manufacture.** Komissarov, S.A.; Safrai, B.A.; Dinzburg, B.N.; Baramboim, N.N.; Ksenofontova, A.N. Translated from *Kozh.-Obuvn. Prom-st.;* **10**: No. 7, 48-51(1968). 7p. Dep. NTIS, PC A02/MF A01.

Fibrous fillers used in a formulation for sole rubbers were studied. Fibrous fillers obtained from the wastes of polyamide (PA), polyethylene terephthalate (PET), and polyacrylonitrile (PAN) were ground in a vibromill to the most probable particle diameters (0.3 mm). Tensile strength, relative elongation, and tear strength of the vulcanizates as a function of the filler content were found and compared with vulcanizates with powdered silica gel. The most effective was the nitron (PAN) fiber. (FS)

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 18573

19165 **Physiochemical characterization of composites and quality control of raw materials.** Penn, L.S. (Univ. of California, Livermore). *Am. Soc. Test. Mater., Spec. Tech. Publ.;* No. 674, 519-532(1979).

A review is given of several methods for determining the chemical and physical (not mechanical) properties of advanced composites. This discussion is not all-inclusive; rather, it is restricted to composites with thermoset matrices, usually epoxies, and to methods that have gained some acceptance among researchers in the composites field. Strictly speaking, mechanical testing is a form of physical characterization but because the subject is amply covered in published literature, it will not be discussed here. Specifically, three steps are discussed of physiochemical characterization of composites: screening and quality control of the raw materials, determining the degree of cure, and characterizing the cured composite. In addition to wet chemical analysis, infrared spectroscopy, nuclear magnetic resonance, and liquid chromatography are recommended for quality control. For cure cycle monitoring, infrared spectroscopy, nuclear magnetic resonance, differential scanning calorimetry, dielectrometry, and torsional braid analysis are reviewed. In addition, the versatility of thermal analysis and the applicability of Raman spectroscopy and infrared spectroscopy are discussed for characterizing cured composites. Finally, we stress the need for standard procedures for screening and quality control of raw materials as well as the need for innovative testing to relate properties of the cured composite to specific service conditions. We also point out the pitfalls of the methods reviewed.

OTHER MATERIALS

19166 (UCID—18574-79-4) **H-Division quarterly report, October-December 1979.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Feb 1980. Contract W-7405-ENG-48. 68p. Dep. NTIS, PC A04/MF A01.

This report defines the objectives of groups in H Division of the LLL Physics Department and describes the status of projects under way: Theoretical EOS Group - equation of state of fluid Ar, LLL tabular EOS library, an EOS and opacity handbook for laser fusion, calculations of the Gruneisen constant for Xe, hypernetted chain results for dense plasma thermodynamics and electrical conductivity, analytical model for suprathermal electron deposition in laser EOS targets: application to design of layered targets; Experimental Physics Group - shock compression of liquid deuterium, flash x-ray diffraction, subnanosecond cable length calibration; Fluid Physics Group - repulsive forces in dense Ar, transient boundary layers in erosive environments. Detailed individual reports on completed work may be expected. 16 figures, 8 tables. (RWR)

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 18562, 18563, 18564, 18565, 18566, 18567, 18568, 18570, 18571, 18572, 18574, 18579, 18582, 18585, 18586, 18587, 18589, 19149

19167 (DOE/ER/10390—1) **Investigation of deep level defects in epitaxial semiconducting zinc sulpho-selenide. Progress report, 15 June 1979-14 June 1980.** Wessels, B.W. (Northwestern Univ., Evanston, IL (USA)). 1980. Contract AC02-79ER10390. 33p. Dep. NTIS, PC A03/MF A01.

In an effort to understand the defect structure of the ternary II-VI compound zinc sulpho-selenide, the binary compound zinc selenide was investigated. Thin single crystalline films of zinc selenide were heteroepitaxially grown on (100) GaAs. Epitaxial layers from 5 to 50 microns thick could be readily grown using a chemical vapor transport technique. The layers had an excellent morphology with few stacking faults and hillocks. Detailed epitaxial growth kinetics were examined as a function of temperature and reactant concentration. It was found that hydrogen flow rate, source and substrate temperature affect the growth rate of the epitaxial films. Au - ZnSe Schottky barrier diodes and ZnSe - GaAs n-p heterojunctions were prepared from the epitaxial layers. Current-voltage characteristics were measured on both types of diodes. From capacitance-voltage measurements the residual doping density of the epitaxial layers were found to be of the order of 10^{14} - 10^{15} cm^{-3}. Finally, we have begun to measure the deep level spectrum of both the Schottky barrier diodes and the heterojunctions. Deep level transient spectroscopy appears to be well suited for determining trapping states in ZnSe provided the material has a low enough resistivity.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 18575, 19134

PROPERTIES

REFER ALSO TO CITATION(S) 19167

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 19768

CHEMISTRY

ANALYTICAL AND SEPARATIONS CHEMISTRY

19168 (IS—4726) **Multilaboratory analytical quality control for the hydrogeochemical and stream sediment reconnaissance.** D'Silva, A.P.; Grabau, F.; Haas, W.J. Jr. (Ames Lab., IA (USA)). Jan 1980. Contract W-7405-NG-82. 44p. Dep. NTIS, PC A03/MF A01.

Ames Laboratory received the following results for the month of December 1979: from Los Alamos Scientific Laboratory,

water A6 - 0.95 ppB U (4F), and water B6 - 9.85 ppB U (4F); from the Oak Ridge Gaseous Diffusion Plant, water A6 - 0.95 ppB U (1F), water B6 - 9.85 ppB U (1F), sediment Q1 - 0.5 ppM U (SF, 4 DNC), sediment R3 - 5 ppM U (2F, 2 DNC), and sediment S3 - 30 ppM U (SF). Fluorometric analysis are indicated by F, and delayed neutron counting analyses are indicated by DNC.

19169 (PB—297451) **Handbook for analytical quality control in water and wastewater laboratories. Final report.** Booth, R.L. (Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab.). Mar 1979. 157p. NTIS, PC A08/MF A01.

This handbook is addressed to laboratory directors, leaders of field investigations, and other personnel who bear responsibility for water and wastewater data. Subject matter of the handbook is concerned primarily with quality control (QC) for chemical and biological tests and measurements. Chapters are also included on QC aspects of sampling, microbiology, biology, radiochemistry, and safety as they relate to water and wastewater pollution control. Sufficient information is offered to allow the reader to inaugurate or reinforce programs of analytical QC that emphasize early recognition, prevention, and correction of factors leading to breakdowns in the validity of water and wastewater pollution control data.

ACTIVATION AND NUCLEAR REACTION PROCEDURES

REFER ALSO TO CITATION(S) 19768

CHEMICAL PROCEDURES

19170 (RHO-SA—115) **High pressure liquid chromatography with element-specific detection.** Nelson, D.E.; Metcalf, S.G. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jun 1979. Contract EY-77-C-06-1030. 14p. (CONF-790666—7). Dep. NTIS, PC A02/MF A01.

From 34. Northwest regional meeting of the American Chemical Society; Richland, WA, USA (13 Jun 1979).

Element-specific detection for HPLC has several advantages over nonelement-specific detection. These are: simpler chromatograms (less peak overlap), faster analysis time (higher flow rates and shorter columns can be used), and less pure and less costly solvents can be used. Three applications (chemical speciation, rare earth separations and EDTA/HEDTA determinations) were discussed but a wide range of potential applications exists. 7 figures.

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 18482, 18484, 18485, 18486, 19176

19171 (LA—8103-M) **Savannah River Plant californium-252 Shuffler electronics manual.** Bourret, S.C.; Crane, T.W.; Eccleston, G.W.; Gallegos, E.A.; Garcia, D.L. (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 32p. Dep. NTIS, PC A03/MF A01.

Detailed information is presented in this report, an electronics manual for the Savannah River Plant Shuffler, about the electronics associated with the various control and data acquisition functions of the Shuffler subsystems. Circuit diagrams, interconnection information, and details about computer control and programming are included.

19172 (LA-UR—80-847) **Instrument for measurement of Pu concentration and isotopics of product solutions at Tokai-mura.** Cowder, L.R.; Hsue, S.T.; Johnson, S.S.; Parker, J.L.; Russo, P.A.; Sprinkle, J.K. Jr.; Asakura, Y.; Fukuda, T.; Kondo, I. (Los Alamos Scientific Lab., NM (USA); Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works). 1980. Contract W-7405-ENG-36. 8p. (CONF-800315—9). Dep. NTIS, PC A02/MF A01.

From 2. symposium of the European Safeguards Research and Development Association; Edinburgh, UK (26 Mar 1980).

Rapid analysis of product solutions for plutonium concentrations and isotopic distributions is accomplished by a new instrument currently installed at the reprocessing plant in Tokai-mura, Japan. Better than half-percent measurements of the Pu concentration are obtained by K-edge densitometry for concentrations ~ 250 g Pu/l in short count times. Isotopic fractions are determined with an accuracy of one percent or better in an additional 30-minute passive count.

19173 (LBL—10487) **Radioisotope detection with accelerators.** Mast, T.S.; Muller, R.A.; Tans, P.P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1979. Contract W-7405-ENG-48. 19p. (CONF-7910123—3). Dep. NTIS, PC A02/MF A01.

From Lunar and Planetary Institute topical conference on the ancient sun; Boulder, CO, USA (Oct 1979).

High energy mass spectrometry is a new and very sensitive technique of measuring rare radioisotopes. This paper describes the techniques used to select and identify the individual radioisotope atoms in a sample and the status of the radioisotope measurements and their applications.

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 18427, 18591

19174 (IS—4712) **Multilaboratory analytical quality control for the hydrogeochemical and stream sediment reconnaissance. Quality control report for July 1979.** D'Silva, A.P.; Floyd, M.A.; Haas, W.J. Jr. (Ames Lab., IA (USA)). Aug 1979. Contract W-7405-ENG-82. 21p. Dep. NTIS, MF A01.

Portions of document are illegible.

The Ames Laboratory received the following number of results for July 1979: from Los Alamos Scientific Laboratory, water A5 - 0.98 ppB U (4F), water B5 - 9.00 ppB U (4F); and from the Oak Ridge Gaseous Diffusion Plant, water A5 - 0.98 ppB U (7F), water B5 - 9.00 ppB U (2F), sediment R3 - 5 ppM U (3F), and sediment S1 - 10 ppM U (5F). Fluorometric analyses are indicated by F.

19175 (IS—4728) **Development of multielement sampling and analyses methods using inductively coupled plasma-atomic emission spectroscopy.** Haas, W.J. Jr.; Olson, K.W.; Fassel, V.A.; DeKalb, E.L. (Ames Lab., IA (USA)). Feb 1980. Contract W-7405-ENG-82. 114p. Dep. NTIS, PC A06/MF A01.

Progress made in the following tasks is reported: determination of trace elements in blood; determination of trace elements in urine; determination of trace elements in air particulates; collection and presentation of data for independent evaluation by the National Institute for Occupational Safety and Health (NIOSH); methods; and preparation of procurement specifications for a NIOSH ICP-AES system. Air particulates are analyzed for As, Be, Cd, Cr, Cu, Fe, Pb, V, and Zn; urine is analyzed for Al, As, B, Be, Cd, Co, Cr, Cu, Mn, Ni, Pb, Se, and V.

19176 **Synthesis and characterization of the metamagnetic 1:1 1-D phase of the decamethylferrocenium 7,7,8,8-tetracyano-p-quinodimethanide: $Fe[C_5(CH_3)_5]_2^+.(TCNQ)^-$.** Miller, J.S. (Occidental Research Corp., Irvine, CA); Reis, A.H. Jr.; Gebert, E.; Ritsko, J.J.; Salaneck, W.R.; Kovnat, L.; Cape, T.W.; Van Duyne, R.P. *J. Am. Chem. Soc.*; **101**: No. 23, 7111-7113(7 Nov 1979).

The characterization of the metamagnetic phase II material, $(DMeFc^+.)(TCNQ^-.)$ is reported. Also showed is structural evidence for the formation of α, α-dicyano-p-toluoylcyanide anions, formed from the solid state reaction of $(DMeFc^+.)(TCNQ^-.)$ and air. This structure of the reaction product between metamagnetic phase II $(DMeFc^+.)(TCNQ^-)$ and oxygen was determined and showed that it is isomorphic with the unreacted 1:1 phase and it is comprised of isolated S = 1/2 $DMeFc^+$. and S = 1/2 $TCNQ^-$. ions. The oxidized $TCNQ^-$ forms $DCTC^-$., (α,α-dicyano-p-toluoylcyanide anion) which was confirmed spectroscopically and crystallographically. The absorption spectra with vibrational fine structure of detailed isolated $TCNQ^-$. in the solid state is reported here for the first time. 2 figures, 1 table. (DP)

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 19184

19177 (DP-MS—79-48) **Separation of macro quantities of actinides by high-pressure cation exchange.** Burney, G.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1979. Contract EY-76-C-09-0001. 24p. (CONF-7910108—2). Dep. NTIS, PC A02/MF A01.

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (30 Oct 1979).

Several kilograms of ^{244}Cm and ^{243}Am and several milligrams of ^{252}Cf were produced by irradiation of a mixture of plutonium isotopes. The plutonium was separated by solvent extraction, and the other actinides were separted from each other and from large quantities of fission-product rare earths by displacement-development chromatography in a system of pressurized steel columns in high level caves. The elutriant was 0.05 M DTPA buffered with ammonium hydroxide. Part of one of the large radiochemical separation plants at SRP has been converted to a heavily shielded eight cell master slave manipulator-operated facility (MPPF) for separation and purification of actinide elements by a pressurized cation-exchange system.

19178 (PB—296153) **Determination of radium removal efficiencies in Illinois water supply treatment processes. Technical note.** Bennett, D.L.; Bell, C.R.; Markwood, I.M. (Office of Radiation Programs, Washington, DC (USA). Technology Assessment Div.). May 1976. 121p. NTIS, PC A06/MF A01.

Five water supplies, which were known to have radium-226 in the raw water (ranging from 3.3 to 14.7 pCi/l) and which have existing water softening equipment, were chosen to determine the efficiency of radium removal. Plants using ion exchange and lime

water softening processes were investigated. At the plants using ion exchange softening, samples of raw, aerated, and softened water were collected, analyzed for radium-226 and mineral content, and the radium removal efficiency was calculated. At the plants using lime softening, samples of raw and filtered water were analyzed. All plants were operated in a normal manner during sampling. In general, the ion exchange softening removed the radium-226 more efficiently with 70.2 to 98.2% being removed as compared to 70 to 92% for lime softening. Although the removal efficiency was somewhat lower using lime softening, it was more consistent since the problem of breakthrough at the end of a softener run was not experienced and little or no blend water is required to produce a stable product.

19179 Niobium(V) extraction by butyl lauryl phosphoric acid-dodecane from nitric acid. Maya, L.; Hydzik, R.J.; Haas, J.A. (Oak Ridge National Lab., TN (USA)). *J. Inorg. Nucl. Chem.;* **41**: No. 8, 1193-1198(1979).

Extraction of niobium by tributyl phosphate (TBP) in the Purex process is inefficient; and in spite of this, niobium is found in solvent streams. Alternate mechanisms for niobium transfer into the solvent were sought. Butyl lauryl phosphoric acid (HBLP), a model compound of secondary degradation products of the solvent used in the process, was found to enhance niobium extraction above a threshold concentration of 5×10^{-4} M. A study of the niobium distribution coefficient dependences in the system HNO_3-HBLP-dodecane on the HBLP, hydrogen ion and nitrate ion concentration suggests an extraction mechanism involving neutralization of an hydroxyl group bound to the niobium and no incorporation of nitrate into the extracted species. These results are supported by chemical analysis of the extracted species which show an empirical formula corresponding to $Nb(OH)_4BLP$. Silica and zirconium monobutyl phosphate, under certain conditions, disperse adsorbed niobium in the solvent phase in the form of emulsions or suspensions. Centrifugation of these give no net enhancement of niobium transfer.

INORGANIC AND PHYSICAL CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 19021, 19176, 19193, 19194

19180 (LBL—9510) **Proceedings of the workshop stochastic molecular dynamics. NRCC Proceedings No. 6.** Ceperley, D.; Tully, J. (eds.). (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1979. Contract W-7405-ENG-48. 69p. (CONF-790735—). Dep. NTIS, PC A04/MF A01.

From Stochastic molecular dynamics conference; Woods Hole, MA, USA (8 Jul 1979).

Twenty papers are included which discuss methods for incorporating effects of surrounding media and for reducing the number of degrees of freedom by means of stochastic elements in molecular dynamics simulations. Many of the critical problems which currently limit the utility of molecular dynamics, stochastic dynamics, and Monte Carlo simulations were examined. Condensed phase processes, polymer motion, surface chemistry, and gas-phase dynamics were explored. (DLC)

19181 (SAN—0034-T6) **Nuclear methods in chemical kinetics. Technical progress report, April 1, 1979-March 31, 1980.** (California Univ., Davis (USA)). 1979. Contract EY-76-S-03-0034-158. 28p. Dep. NTIS, PC A03/MF A01.

The 1979-1980 research proposal included the following projects: (1) Gas-Phase Thermal F-to-HF Reactions; (2) Gas-Phase Thermal ^{18}F Olefinic Addition Reactions; (3) Energetics Perturbation of Hot F-for-F Substitution in CF_4; and (4) Liquid-Phase Thermal F-to-HF Reactions. Research in the first three of these areas has been completed. In addition, a single-channel modification of realistic potential kinetic collision theory for activationless processes was developed and tested using literature ^{19}F NMR data for rotational relaxation in CF_4 and SF_6. The theory was also shown to provide a quantitative basis for the analysis of thermal F-to-HF rate constants.

19182 Structure and oxidation states of Ir and Pt one-dimensional inorganic complexes. Reis, A.H. Jr.; Peterson, S.W. (Argonne National Lab., IL). *Ann. N.Y. Acad. Sci.;* **313**: 560-579(29 Sep 1978).

This paper reviews attempts to accurately characterize several anisotropically conducting inorganic complexes. Structural data are presented on $K_2Pt(CN)_4.3H_2O$, $K_{1.75}Pt(CN)_4.1.5H_2O$, $K_{1.6}Pt(C_2O_4)_2.1.2H_2O$, and $Ir(CO)_2Cl$. In this discussion, emphasis is placed on the relationship of the structural properties, metal-metal distance and ligand conformation, and the partial oxidation state of the metal. 31 references, 19 figures, 2 tables.

19183 Computer modeling of quantum liquids and crystals. Kalos, M.H.; Whitlock, P.A.; Ceperley, D.M. (Courant Inst. of Mathematical Sciences, New York, NY). *ACS Symp. Ser.;* No. 86, 219-230(1978).

A brief review of some new models for the Monte Carlo modeling of quantum systems is presented. Applications of the Monte Carlo and the Green's function Monte Carlo methods to the study of helium-3 and helium-4 liquids and to crystals with two body potentials is discussed. 20 references, 1 figure.

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 18391

ORGANIC CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 18305, 19714

19184 (CONF-800328—1) **Continuous chromatographic reactor.** Cho, B.K.; Carr, R.W. Jr.; Aris, R. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science). 1980. Contract EY-76-S-02-2945. 8p. Dep. NTIS, PC A02/MF A01.

From 6. ISCRE; Nice, France (25 Mar 1980).

Reaction chromatography has been done on a continuous basis in a reactor configuration consisting of a packed cylindrical annulus with a rotating feed port. Chromatographic action causes spatial separation of product streams emerging from the annular exit. This has been demonstrated by an experimental study of the acid catalyzed hydrolysis of aqueous methyl formate. Furthermore, separation of the products, formic acid and methanol, suppresses the reverse reaction causing conversions to be significantly greater than equilibrium conversions. A mathematical model of the reactor has been developed and used for numerical simulation of reactor behavior. Dispersion characteristics of the bed, adsorption isotherms and reaction kinetics were all determined in independent experiments, and used as input data for the model. Comparisons of numerically simulated reactor performance with experimental results showed good agreement.

19185 (LBL—10069) **Investigation of the degradation of propylene carbonate by chlorine.** Yu, S.M.G.; Ross, P.N.; Tobias, C.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-ENG-48. 32p. Dep. NTIS, PC A03/MF A01.

Chlorine was found to degrade a very carefully purified propylene carbonate solvent. Water present in the solvent at a few parts per million level is identified to be the cause of the degradation. It is shown that water not only affects the rate, but also the extent of the degradation. An order of magnitude estimate indicates that 10 ppM of water causes a tenfold increase in both the rate and the extent of the degradation. Treated Nafion membrane was found to be adequate for confining chlorine evolution and hence solvent degradation to only the anodic chamber. Potassium was simultaneously deposited in the cathodic chamber where no solvent degradation was observed. The chlorine evolution potential of a 0.5M $KalCl_4$ in propylene carbonate relative to a potassium reference electrode was determined by voltammetry to be 3.5 volts.

19186 (UCRL—82863) **Reaction kinetics of phenyl glycidyl ether with 2,5-dimethyl-2,5-hexanediamine.** Rinde, J.A.; Happe, J.A.; Newey, H.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Oct 1979. Contract W-7405-ENG-48. 18p. (CONF-800514—1). Dep. NTIS, PC A02/MF A01.

From 38. annual technical conference of the Society of Plastics Engineers; New York, NY, USA (5 May 1980).

The reaction rate of phenyl glycidyl ether with the amine 2,5-dimethyl-2,5-hexanediamine has been measured in dimethyl sulfoxide solution at four temperatures from 46 to 100°C. Carbon-13 NMR was used to monitor the concentrations of reactants and products. Using this technique we were able to measure independently the reaction rates of both the primary and secondary amine hydrogens. The ratio of reaction rates k_1/k_2 is 60:1, the largest ratio ever reported. The activation energy for either reaction is 13.7 kcal/mole. The reactions are catalyzed by hydroxyl groups, and the mechanism used to explain our data is consistent with those of previous workers. 7 figures.

19187 Tunneling corrections to unimolecular rate constants, with application to formaldehyde. Miller, W.H. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *J. Am. Chem. Soc.;* **101**: No. 23, 6810-6814(7 Nov 1979).

Tunneling corrections to the rate constant for unimolecular reactions in an isolated molecule are treated within the standard transition state (i.e., RRKM) theory of such processes. The microcanonical distribution relevant to the unimolecular case causes tunneling effects to enter in a somewhat more complicated fashion than in the analogous transition-state theory for thermally averaged bimo-

lecular rate constants; e.g., even within the separable approximation they do not enter as simply a multiplicative correction factor. Application of the theoretical expressions to some unimolecular processes ($H_2CO \rightarrow H_2 + CO$, trans-$HCOH \rightarrow H_2CO$) of interest in the collisionless photochemistry of formaldehyde indicates that tunneling effects are quite significant for rates of 10^9 s^{-1} or slower. Isotope effects are also considered and seen to be quite interesting. 4 figures, 1 table.

ELECTROCHEMISTRY

19188 Mass transfer at rotating finned cylinders. Sedahmed, G.H. (Alexandria Univ., Egypt); Abdel Khalik, A.; Abdallah, A.M.; Farahat, M.M. *J. Appl. Electrochem.;* **9**: No. 5, 563-566(Sep 1979).

Rates of mass transfer at rotating finned cylinders were studied by an electrochemical technique involving the measurement of the limiting current for the cathodic reduction of potassium ferricyanide in a large excess of sodium hydroxide. The variables studied were fin height and Reynolds number. The ratio of the fin height to the cylinder diameter (e/d) ranged from 0.0185 to 0.075 while the Reynolds number ranged from 1047 to 10470. Under these conditions, the mass transfer data could be correlated by the equation $J = 0.714(Re)^{-0.39}(e/d)^{0.2}$.

19189 Mass transfer between rough surfaces and solutions containing drag-reducing polymers. Sedahmed, G.H. (Alexandria Univ., Egypt); Abdel Khalik, A.; Abdallah, A.M.; Farahat, M.M. *J. Appl. Electrochem.;* **9**: No. 5, 567-572(Sep 1979).

Rates of electrochemical mass transfer were measured between finned rotating cylinders and solutions containing drag-reducing polymers. Variables studied were: Reynolds number, polymer concentration and fin height. Polyox and carboxymethyl cellulose (CMC) were used as drag-reducing polymers with concentrations ranging from 10 to 100 ppM for polyox and from 10 to 500 ppM for CMC. Cylinders with longitudinal fins of e/d ranging from 0.0185 to 0.075 were used. Reynolds number was varied between 1000 to 10,000. It was found that the presence of fins on the cylinder surface reduces the adverse effect of the polymer on the rate of mass transfer, the higher the fin height the lower is the ability of the polymer to reduce the rate of mass transfer. Mass transfer data for solutions containing polyox were correlated by the equation: $(St) = 0.765(Re)^{-0.36}(Sc)\text{-}0.669(e/d)^{0.36}$. Mass transfer data for solutions containing CMC were correlated by the equation: $(St) = 1.704(Re)^{-0.36}(Sc)^{-0.75}(e/d)^{0.315}$.

PHOTOCHEMISTRY

19190 (COO—4395-1) **Influence of phase boundaries on photoinduced electron transfer reactions. Final report, July 1, 1977-August 31, 1979.** (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). Aug 1979. Contract EG-77-C-02-4395. 9p. Dep. NTIS, PC A02/MF A01.

A summary is presented of results of research which was conducted on bipyridyl complexes of ruthenium, with the objective of storing visible light energy. The research covered analytical techniques, synthesis, properties of Ru complexes in monolayers and micelles, and luminescence quenching. 23 references. (DLC)

19191 Mechanistic photochemistry of transition metal β-diketonate complexes. The case of trans-tris(1,1,1-trifluoro-2,4-pentanedionato)rhodium(III). Kutal, C. (Univ. of Georgia, Athens); Grutsch, P.A.; Ferraudi, G. *J. Am. Chem. Soc.;* **101**: No. 23, 6884-6890(7 Nov 1979).

A photochemical study of trans-$Rh(tfa)_3$ (tfa is the anion of 1,1,1-trifluoro-2,4,-pentanedione) has revealed the occurrence of two photoinduced processes whose relative quantum efficiencies exhibit a striking dependence upon the solution environment. Thus trans to cis isomerization is the sole observable photoprocess in cyclohexane, whereas only decomposition of the complex occurs in ethanol and 2-propanol. The key role of solvent in regulating the photochemical behavior is particularly evident in mixed cyclohexane-2-propanol systems where both photoprocesses can be observed. Oxygen quenching and wavelength-dependence studies provide strong evidence for the existence of two photoactive excited states in trans-$Rh(tfa)_3$. The enhanced photoreactivity in the presence of hydrogen atom donors suggests that one or both of these photoactive states imparts considerable radical character to the complex. Flash photolysis results obtained under a variety of experimental conditions support this suggestion and allow a more precise delineation of several steps in the overall reaction sequence. 7 figures, 4 tables.

19192 Photoenolization of o-alkyl-substituted carbonyl compounds. Use of electron transfer processes to characterize transient intermediates. Das, P.K.; Encinas, M.V.; Small, R.D. Jr.; Scaiano, J.C. (Univ. of Notre Dame, IN). *J. Am. Chem. Soc.;* **101**: No. 23, 6965-6970(7 Nov 1979).

Intramolecular hydrogen transfer in photoexcited o-methyl-substituted carbonyl compounds leads to the formation of short-lived biradicals which decay to yield unstable enols. The biradicals can be trapped with suitable electron acceptors, and a study of these processes leads to the measurement of biradical lifetimes, quantum yields, and their rates of electron transfer. The combination of these studies with quenching of the process by 1,3-pentadiene leads to the evaluation of the number and lifetime of the triplet state precursors. Ground-state conformation plays an important role in determining the nature and kinetics of triplet state processes. In a typical example, o-methylbenzaldehyde, two triplet states are responsible for biradical production; they have lifetimes of 1.1 and 95 ns in wet acetonitrile and account for 58% and 42% of the reaction, respectively. The biradicals are generated with a quantum yield of 0.83, live 1500 ns, and transfer an electron to paraquat dications with a rate constant of 6.2×10^9 $M^{-1}s^{-1}$. 5 figures, 2 tables.

19193 (UCRL-Trans—11529) **Photochemical reactivation of the hydrogenation catalyst $RhHCO(PPh_3)_3$: preliminary communication.** Strohmeier, W.; Csontos, G. Translated from *J. Organomet. Chem.;* **67**: C27-C29(1974). 6p. Dep. NTIS, PC A02/MF A01.

The activity of the hydrogenation catalyst $RhHCO(PPh_3)_3$ decreases with time. The catalyst can be reactivated under weak uv-irradiation.

19194 (UCRL-Trans—11530) **Photochemical activation of the hydrogenation catalyst $IrCl(CO)(PPh_3)_2$.** Strohmeier, W.; Csontos, G. Translated from *J. Organomet. Chem.;* **72**: 277-282(1974). 11p. Dep. NTIS, PC A02/MF A01.

Under weak uv irradiation (flux: 2.4 mmol $h\nu$/h) the activity of the hydrogenation catalyst $IrCl(CO)(PPh_3)_2$ is increased by a factor up to 40. Reactive intermediates are formed in reversible and irreversible steps. Once the active intermediate is produced in the irreversible step fast hydrogenation can be carried out even in the dark.

RADIATION CHEMISTRY

REFER ALSO TO CITATION(S) 18448, 18449

19195 Electron transfer from ascorbic acid to various phenothiazine radicals. Pelizzetti, E. (Universita de Torino, Italy); Meisel, D.; Mulac, W.A.; Neta, P. *J. Am. Chem. Soc.;* **101**: No. 23, 6954-6959(7 Nov 1979).

The reaction of electron transfer from ascorbic acid to N-alkylphenothiazine radical cations was studied in the pH range 0 to 7.2. The radical cations were produced by oxidation with Br_2^- or Cl_2^- using the pulse radiolysis technique. The radical cations are reduced by the deprotonated form of ascorbic acid in the pH range 2.2 to 7.2. The product of this reaction has a spectrum which is identical with that of the ascorbate radical. It is concluded that, if a charge-transfer complex is formed upon the reaction of ascorbic acid with the phenothiazine radical cations, its lifetime is shorter than 7×10^{-9}s. It is suggested that even at high acidities no long lived complex is formed and it is proposed that at very low pH the thermodynamically stable species in this reaction is the phenothiazine radical cation rather than the ascorbic acid radical. It is shown experimentally that at 1 M HCl the ascorbic acid radical oxidizes N-alkylphenothiazine to give the radical cation of the latter in reverse to the direction of the electron transfer at higher pH. 8 figures, 2 tables.

19196 (BNL-tr—691) **Investigation of radiation resistance of natural rock salt.** Spitsyn, V.I.; Barsova, L.I.; Kabakchi, S.A.; Zyazyulya, I.I.; Lebedeva, I.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). 1979. Translation of Preprint IAEA-SM—243/109. 17p. Dep. NTIS, PC A02/MF A01.

The physicochemical processes in samples of rock salt of different deposits, which occur as a result of the action of γ radiation in a wide dose range, are investigated. The nature and kinetics of accumulation of electron and hole centers are investigated relative to the impurity content, absorbed dose, and temperature. The formation of F, M, and V centers is demonstrated and the processes of thermal and radiation coagulation of these centers to colloidal sodium and chlorine gas are studied. The dose absorbed by the crystal can be determined from the number of produced F centers. The efficiency of liberating gaseous products, mainly molecular chlorine, depends on the impurity content. The molecular hydrogen and hydrogen peroxide are produced as a result of dissolving irradiated samples of rock salt. There is a linear correlation between the quantity of produced hydrogen and the concentration of F centers in the sample. A method of determining the energy stored by the crystal from the amount of liberated hydrogen is proposed. The variation of microhardness and brittleness of the rock salt samples of

different deposits, which were irradiated in a wide dose range (to 8000 Mrad), is investigated. It is shown that the kinetics of variation of microhardness and maximum radiation hardening of crystals depend on the radiation-induced defects and on impurities.

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

PROPERTIES OF RADIOACTIVE MATERIALS

19197 (CONF-800336—1) **Selenium and tellurium as carbon substitutes.** Knapp, F.F. Jr. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 78p. Dep. NTIS, PC A05/MF A01.

From Radiopharmaceuticals: structure activity relationships symposium; Hartford, CT, USA (21 Mar 1980).

This review has summarized structure-activity studies with ^{75}Se- and /sup 123m/Te-labeled radiopharmaceuticals in which the selenium or tellurium heteroatom has been inserted between carbon-carbon bonds. The agents that have been investigated in most detail include steroids for adrenal imaging and long-chain fatty acids, and a variety of other unique agents have also been studied. Because of the great versatility of the organic chemistry of selenium and tellurium, there is continuing interest in the preparation of radiopharmaceuticals labeled with ^{75}Se, ^{73}Se, and /sup 123m/Te. There are two important factors which will determine the extent of future interest in such agents. These include the necessity of a decrease in the cost of highly enriched ^{122}Te to make the reactor production of /sup 123m/Te cost effective. In addition, the potential preparation of large amounts of ^{73}Se should stimulate the development of ^{73}Se-labeled radiopharmaceuticals.

19198 (LBL—10497) **I. The synthesis and characterization of annulated uranocenes. II. The variable temperature ^{1}H NMR of uranocenes.** Luke, W.D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1980. Contract W-7405-ENG-48. 343p. Dep. NTIS, PC A15/MF A01.

Thesis.

A general synthetic route to alkyl annulated cyclooctatetraene dianions and the corresponding annulated uranocenes has been developed. Dideprotonation of bicyclooctatrienes, resulting from reaction of cyclooctatetraene dianion with l,n-dialkylbromides or methanesulfonates, affords alkyl annulated cyclooctatetraene dianions in moderate yields. Dicyclopenteno-, bisdimethylcyclopenteno- and dicyclohexenouranocene were prepared from the corresponding cyclooctatetraene dianions and UCl_4. The structures of dicyclobuteno- and dicyclopentenouranocene were elucidated by single crystal X-ray diffraction, and the effects of annulation on the uranocene skeleton are discussed. Attempted synthesis of benzocyclooctatetraene and a benzannulated uranocene is reported. The variable temperature ^{1}H NMR spectrum of uranocene has been reinvestigated from -100 to 100°C. The isotropic shift was found to be linear in T^{-1} with an extrapolated intercept of 0 at $T^{-1} = 0$. Variable temperature ^{1}H NMR spectra, from -80 to 70°C, of 17 substituted uranocenes are reported. The energy barrier to ring rotation in 1,1′, 4,4′-tetra-t-butyl-uranocene was determined to be 8.24 +- 0.5 kcal/mole while the barrier in the corresponding 1,1′, 3,3′-tetra-t-butylferrocene was determined to be 13.1 kcal/mole. Alkyl substitution is shown to have little effect on the electronic and magnetic properties of the uranocene skeleton, and thus alkyl substituted uranocenes are treated as having effective axial symmetry in analysis of the observed isotropic shifts. Using diannulated uranocenes as model systems an analysis of the contact and pseudocontact components of the observed isotropic shifts in uranocene and alkyl substituted uranocenes is presented.

19199 (PNL-SA—7352(Vol.1), pp 59-68) **Solution species of ^{239}Pu in oxidizing environments: I. Polymeric Pu(IV).** Rai, D.; Serne, R.J. (Battelle Pacific Northwest Labs., Richland, WA). 1978.

From 2. contractor information meeting; Seattle, WA, USA (1 Oct 1978).

The uncertainties regarding the presence of Pu(IV) polymer in environmental studies is a source of error in evaluation of adsorption and in estimation of Pu migration rates. Our data suggest that Pu(IV) polymer is similar to $Pu(OH)_4$ in its solubility and that the presence of the polymer may be predicted from pH and total Pu in solution.

19200 (PNL-SA—7352(Vol.1), pp 69-95) **Solution species of ^{239}Pu [V] in the environment.** Rai, D.; Serne, R.J.; Swanson, J.L. (Battelle Pacific Northwest Labs., Richland, WA). 1978.

From 2. contractor information meeting; Seattle, WA, USA (1 Oct 1978).

Information regarding the oxidation states of Pu in environmental samples is needed for estimating its migration through the geologic media. Thermodynamic data were used to develop stability fields for different Pu species. The data indicate that in the Eh-pH range of natural aqueous environments, the dominant species of Pu is likely to be Pu[V] in relatively oxidizing environments and Pu[III] in reducing environments. Because of the lack of methods of determining Pu[V] in environmental samples containing trace concentrations of Pu, Pu[V] has not been previously identified in these samples. Plutonium [VI] is generally assumed to be the dominant species in relatively oxidizing environments. However, a combination of solvent extraction and spectrophotometric techniques used in this study show that solutions ($> 10^{-5\ 4}$ M Pu) in equilibrium with ^{239}Pu[IV] hydroxide contain Pu[V], which is in agreement with the thermodynamic predictions. Although this method could not be used conclusively with the remaining solutions ($< 10^{-5\ 4}$ M Pu) contacting ^{239}Pu[IV] hydroxide and $^{239}PuO_2$, the solvent extraction and Eh-pH results are similar for all the samples suggesting the strong possibility that all samples contain Pu[V]. Thus the possibility, ignored in the past, that Pu[V] may be the dominant species in relatively oxidizing environments should be considered.

RADIOISOTOPE PRODUCTION

REFER ALSO TO CITATION(S) 18443

COMBUSTION, PYROLYSIS, AND HIGH-TEMPERATURE CHEMISTRY

19201 (AD-A—074221/3) **Kinetics of hydrogen-oxygen and hydrocarbon-oxygen reactions. Interim report, 1 April 1977-30 June 1979.** Baldwin, R.R.; Walker, R.W. (Hull Univ. (UK). Dept. of Chemistry). Jun 1979. 35p. NTIS PC A03/MF A01.

(1) Refinement of the rate constants obtained from studies of the H2+O2 reaction at 500 degrees C has continued. (2) Rate constants for the reactions of H atoms and OH radicals with C2-C5 alkanes have been refined, and Arrhenius parameters obtained. New studies have been made of the addition of 2,2,3,3-tetrameth ylbutane and 2,2,3-trimethylbutane to slowly reacting mixtures of H2+O2 at 480 degrees C. (3) The mechanism of CO2 formation in propionaldehyde oxidation, and of acetone formation in isobutyraldehyde oxidation at 440 degrees C has been examined. Rate constants have been obtained for the initiation process and for attack of HO2 at the various C-H bonds. (4) The homogeneous decomposition of 2,2,3,3-tetramethylbutane in the presence of O2 has provided a source of HO2 radicals and preliminary rate constants for HO2+TMB, and for HO2+C2H6 have been obtained at 440 debrees C. The Thermochemistry of the t-butyl radical, and its reaction with H2 and O2 have been discussed. (5) Interpretation of the N2O+H2 reaction continues. (Author)

19202 (LBL—10254) **Characterization studies of the selective reduction of NO by NH_3.** Brown, N.J.; Sawyer, R.F.; Eitzen, T.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1979. Contract W-7405-ENG-48. 61p. Dep. NTIS, PC A04/MF A01.

A set of experiments which characterize, in part, the selective reduction of NO via NH_3 in the post combustion gases of propane/air in a laboratory scale combustion tunnel is described. The newly constructed tunnel supports steady state reproducible turbulent combustion under a variety of operating conditions. The prototype fuel nitrogen compound used throughout the study was NO. The important experimental variables considered in the study are: equivalence ratio, NO concentration prior to reduction, temperature, and NH_3 concentration added to the product gases. Results are analyzed in terms of NO survival and NH_3 emissions. The NO survival was found to be in the range 97 to 13 percent for the variables considered. The survival of NO and the NH_3 emissions were found to be especially sensitive to operating conditions.

19203 (SAND—80-8209) **Fundamental combustion and diagnostics research at Sandia. Progress report, October-December 1979.** Gusinow, M.A. (ed.). (Sandia Labs., Livermore, CA (USA)). Mar 1980. Contract EY-76-C-04-0789. 39p. Dep. NTIS, PC A03/MF A01.

The combustion research at Sandia Laboratories sponsored by the Division of Basic Energy Sciences emphasizes basic research into fundamental problems associated with combustion. Special emphasis is placed on the development and application of advanced research methods. The overall program addresses: (1) detailed chemistry of combustion, (2) fundamental processes associated in laminar and turbulent flames, (3) development of research techniques specifically applicable to combustion environments, and (4) operation of the user-oriented Combustion Research Facility. Attached are status reports on the research sponsored by DBES. The first section contains activities in Combustion Research; the second section contains activities in Molecular Physics and Spectroscopy and the third section contains activities in Diagnostics Research. The results reported in these three sections is either completed or at an advanced stage. The work presented in the sections entitled Work in Progress

represents research in its initial stages. Status of the CRF construction and operation are reported elsewhere.

ENGINEERING

FACILITIES AND EQUIPMENT

19204 (SAND—79-1937C) **Application of wind data toward revision of the ANSI wind loads standard.** Church, H.W. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 10p. (CONF-800327—1). Dep. NTIS, PC A02/MF A01.

From 2. joint conference on applications of air pollution meteorology; New Orleans, LA, USA (24 Mar 1980).

The American National Standards Institute provides the machinery for creating voluntary standards which represent general agreement among maker, seller, and user. The ANSI A58.1 standard: Building Code Requirements for Minimum Design Loads in Buildings and Other Structures, last revised in 1972, is currently undergoing the consensus phase toward its scheduled 1980 revision and publication. This standard is intended to provide minimum load requirements for the design of building code requirements. The A58 Windloads Subcommittee has produced an updated national map of annual probable extreme wind speeds to be used in assessing wind loads on structures. After a brief review of previous wind map versions, data selection criteria establishment and collection, data homogenization and reduction, statistical analysis, extreme wind field map analysis, and treatment of special regions are discussed. Finally, some of the data problem areas are discussed with some suggestions offered for their improvement.

19205 (UCID—18566) **Modal analysis using the T-DAC computer system.** Posehn, M.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Feb 1980. Contract W-7405-ENG-48. 71p. Dep. NTIS, PC A04/MF A01.

A versatile combination of hardware and software on the LLL T-DAC computer system has been developed that permits rapid and accurate modal analysis of complex mechanical structures under field conditions. Natural frequencies of vibration and values of damping are interactively determined from experimental data acquired directly by the system. The computed mode shapes are then illustrated by an animated three-dimensional CRT display.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 19850, 19851, 19852, 19853, 19854

19206 (AD-A—074056/3) **Superconducting microwave pulse amplifier. Final report.** Birx, D.L.; Dick, G.J.; Little, W.A.; Mercereau, J.E.; Scalapino, D.J. (Research Advisory Inst., Inc., South Laguna, CA (USA)). Jul 1979. Contract N00014-75-C-1115. 24p. NTIS PC A02/MF A01.

This report summarizes the preliminary research and development of a new and novel technique for very high power microwave pulse amplification. The technique is based on the principle of time compression and is most efficient when utilized in conjunction with superconducting (cryogenic) components. However, it has also been shown to be applicable as a purely ambient temperature device. Very high power microwave pulses appear to be feasible with this technique.

PROTECTIVE STRUCTURES AND EQUIPMENT

REFER ALSO TO CITATION(S) 19721

HANDLING EQUIPMENT AND PROCEDURES

19207 (LA—7170-MS-Suppl.)) **Experimental criticality specifications, update through 1979. Informal report.** Paxton, H.C. (comp.). (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7405-ENG-36. 7p. Dep. NTIS, PC A02/MF A01.

A table of contents for LA-7170-MS is provided, and publications of criticality specifications that appeared in 1978 and 1979 are listed. The table was omitted from the original document. An abstract of the original report appeared in Energy Research Abstracts, Volume 3: 43410.

SHIPPING CONTAINERS

19208 (LA—8120-MS) **Effects of drop testing on scale model shipping containers shielded with depleted uranium.** Butler, T.A. (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7405-ENG-36. 25p. Dep. NTIS, PC A02/MF A01.

Three scale model shipping containers shielded with depleted uranium were dropped onto an essentially unyielding surface from various heights to determine their margins to failure. This report presents the results of a thorough posttest examination of the models to check for basic structural integrity, shielding integrity, and deformations. Because of unexpected behavior exhibited by the depleted uranium shielding, several tests were performed to further characterize its mechanical properties. Based on results of the investigations, recommendations are made for improved container design and for applying the results to full-scale containers. Even though the specimens incorporated specific design features, the results of this study are generally applicable to any container design using depleted uranium.

TRANSPORT AND STORAGE FACILITIES

19209 (AD-A—074297/3) **Systems analysis of methods for installing fuel transport systems. Final report, 1 January-30 June 1979.** Rosenfield, D.B.; Bode, R.H.; Loeffler, H.H.; Nainis, W.S. (Little (Arthur D.), Inc., Cambridge, MA (USA)). 30 Jun 1979. Contract DAAK70-77-D-0024. 145p. NTIS PC A07/MF A01.

A systems analysis was performed to evaluate different types of rapid pipeline construction systems and other methods for installing fuel transport systems. The present manual construction methods do not meet the U.S. Army goals of laying 30 kilometers per 20 hour day. The systems analysis consisted of two phases of evaluating and scoring system attributes for numerous proposed systems. Five systems were considered for the second phase analysis, and two of these merit consideration for future development. These consist of a mechanized pipelaying machine using sectioned pipes with a joint to be designed and a system of collapsible, medium pressure hose. The hose involves more development and does not score as highly in performance and reliability. However, the hose is less expensive and easier to install and therefore merits first consideration.

LASERS

19210 (AD-A—073888/0) **Stimulated emission by relativistic electrons traversing a periodic magnetic field. Master's thesis.** Ellis, R.B. (Naval Postgraduate School, Monterey, CA (USA)). Jun 1979. 72p. NTIS PC A04/MF A01.

A historical survey of scientific developments predating the free electron laser (FEL) concept is presented. A general theory of operation of the FEL is discussed. The use of electromagnets to generate a static periodic magnetic field of alternating polarity (as a pump wave source) is proposed. Preliminary measurements with respect to the proposed electromagnet design are analyzed.

19211 (SAND—79-2138) **Simulations of the effect of applied magnetic fields on reb diodes for laser excitation.** Quintenz, J.P.; Buttram, M.T. (Sandia Labs., Albuquerque, NM (USA)). Jan 1980. Contract EY-76-C-04-0789. 25p. Dep. NTIS, PC A02/MF A01.

Electron beam diodes with sharp edge cathodes and planar anodes of the type typically used for laser excitation are rather well understood and their performance may be characterized by a simple space charge limited flow model. The use of more complex geometry such as a diode with sidewalls or the addition of a magnetic field greatly complicates the situation. A computer code has been developed which simulates such diodes. The code has been used to investigate the effects of applying an external magnetic field on the electron flow pattern in the diode are detailed. Implications for the design of such diodes to meet applications where the survival of the anode foil is critical are discussed.

19212 **Direct pumping of gamma-ray lasers by neutron capture.** Baldwin, G.C.; Solem, J.C. (Univ. of California, Los Alamos, NM). *Nucl. Sci. Eng.*; **72**: No. 3, 290-292(Dec 1979).

The maximum rates of resonance capture of neutrons generated by impulsive fission or fusion sources and moderated in either light or heavy atom moderators are shown to be insufficient for the direct excitation of gamma-ray lasers based on the Moessbauer effect.

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 18900, 18901

19213 (NTIS/PS—79/0652) **Cavitation flow (citations from the International Aerospace Abstracts data base). Report for 1976-May 1979.** Zollars, G.F. (New Mexico Univ., Albuquerque (USA). Technology Application Center). Jul 1979. 45p. NTIS PCN01/MF N01.

These citations from the international literature concern various aspects of cavitation flow. Articles dealing with bubble behavior relating to two phase flow, oscillating flow, unsteady flow, wall flow, and flow stability are cited. (Contains 193 citations)

19214 (UCID—18515) **Fixed and non-fixed length q studies using a 1-D Lagrangian code on the variable zoned I-D hydro shock test problem.** Gee, M.; Kramer, G.; Noh, W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1979. Contract W-7405-ENG-48. 26p. Dep. NTIS, PC A03/MF A01.

A 1-D Lagrangian code that employs a von Neumann-Richtmyer staggered mesh difference scheme was used to investigate the roll of the artificial viscosity, q, in the errors associated with the variable zoned hydro shock problem. In particular, it was found that a fixed length q (i.e., a q which spreads shocks over a fixed physical length) would eliminate this error. Further, the errors associated with the standard use of q which spreads shocks over a fixed number of mesh points was investigated to possibly select a best form.

MATERIALS TESTING

19215 (ANL/MSD—79-7) **Nondestructive evaluation techniques for high-temperature ceramic components. Eighth quarterly report, July-September 1979.** (Argonne National Lab., IL (USA)). Oct 1979. Contract W-31-109-ENG-38. 22p. Dep. NTIS, PC A02/MF A01.

Progress in research on nondestructive techniques for detecting defects in high-temperature structural ceramics is reported. These techniques include dye-enhanced radiography, acoustic microscopy, conventional ultrasonic testing, acoustic-emission detection, acoustic impact testing, holographic interferometry, infrared scanning, internal friction measurements and overload proof testing. The effect of varying microstructure on flaw detectability was demonstrated by comparing ultrasonic signal amplitudes from notches in siliconized and sintered SiC tubes. Signal amplitudes were ~ 4 dB higher in the sintered material. Knoop dents with depths as small as 25 μm, not detectable at conventional operating frequency (10 MHz), were clearly resolved by use of a 75-MHz transducer. The velocity of sound was measured as a function of the volume fraction of silicon in Carborundum KT samples. The results suggest that measurement of the velocity of sound may be adequate for indicating silicon content. Initial data have been presented on flaw detection in SiC tubing with the bore-side ultrasonic probe and acoustic microscope stage. Preliminary results were encouraging. A novel dynamic holography technique was demonstrated. A 100 x 50-mm-deep Knoop indent in a SiC bar could clearly be seen by this technique, which is a significant improvement over previous optical methods. (LCL)

SAFETY ENGINEERING

19216 (UCRL—15201) **Guidelines for the preparation of safety analysis reports.** (Cranston Research, Inc., Alexandria, VA (USA)). 3 Jan 1980. Contract W-7405-ENG-48. 92p. Dep. NTIS, PC A05/MF A01.

These guidelines were prepared by the Office of the Assistant Secretary for Energy Technology for use in the management by program offices, field organizations, and contractors of the operations for the development of the energy technologies under his cognizances. They provide the uniformity necessary for the orderly implementation of the Safety Analysis and Review System (SARS) and preparation of a Safety Analysis Report (SAR). This system and the SAR are designed to assure the identification of hazards, their elimination or control, assessment of the risk, and documented management authorization of ETS operations. Following the presentation of some general instructions in Section I, other sections are devoted to: SAR Scope; SAR Content; and SAR Format.

ELECTRONIC CIRCUITS AND DEVICES

19217 (BDX—613-2428) **Control of electrostatic damage to electronic circuits.** Kirk, W.J. Jr. (Bendix Corp., Kansas City, MO (USA)). Mar 1980. Contract EY-76-C-04-0613. 21p. (CONF-800440—1). Dep. NTIS, PC A02/MF A01.

From 6. annual reliability testing institute; Tucson, AZ, USA (14 Apr 1980).

Static is caused by the flow of materials and people within an environment. The static voltages generated by these movements can degrade or destroy many solid state devices currently being used in sophisticated electronic equipment. Discharge of static voltages through these sensitive devices during assembly operations can lead to a nonfunctional assembly fabricated from parts which previously were acceptable or to later failure of an assembly which was functional after fabrication. Sources of electrostatic charges, equipment and methods for minimizing the generation of electrostatic voltages during the production, assembly and packaging of solid state electronic equipment, and the sensitivity of solid state devices to electrostatic damage are discussed. It is concluded that static awareness is the key to an effective electrostatic damage (ESD) control program, and that production facilities must incorporate electrostatic protection facilities, materials, and processes so that workers can concentrate on producing a high-quality product without having to be overly concerned about ESD procedures. (LCL)

19218 (LA—8242-MS) **Transient response of thin-wire antennas and scatterers loaded with circuits and nonlinear elements.** Landt, J.A. (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7405-ENG-36. 16p. Dep. NTIS, PC A02/MF A01.

A numerical technique is presented that is capable of calculating the transient response of a thin-wire antenna or scatterer loaded by a network. The network may contain nonlinear as well as linear elements. The numerical solution is obtained by a single computer code execution. The formulation is cast in the time domain, and the solution is obtained by a time-stepping procedure. Previously published results are duplicated and new results are presented.

19219 (UCID—18551) **Effect of a peaking circuit on the power rise time in the magnetron.** Pettibone, J.; Craig, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Feb 1978. Contract W-7405-ENG-48. 5p. Dep. NTIS, PC A02/MF A01.

The operation, in terms of power rise time, of a magnetron with and without a peaking circuit was examined theoretically. It was found that without the peaking capacitor, the current struggles slowly to its peak value and the magnetron power rises hesitantly. With the peaking capacitor, the current and voltage struggles up to ~ I_0 and .8 V_0 whereupon the magnetron turns on and the voltage across it rises very rapidly from its threshold value (.8 V_0) to its peak value (V_0). Further considerations lead to the inclusion of a resistance R/sub p/ in series with C/sub p/ to damp large voltage oscillations which may affect the performance of the magnetron. (LCL)

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 18307, 18349, 18372, 18373, 18534

19220 (STU—76-4680) **High speed burner for heavy oil.** Eriksson, I.E.; Oestlund, C. (Styrelsen foer Teknisk Utveckling, Stockholm (Sweden)). Nov 1979. 105p. (In Swedish). Dep. NTIS (US Sales Only), PC A06/MF A01.

A heavy oil burner was designed to obtain reliability, low noise levels and low pollution. The burner uses pneumatic ultrasound cracking of the heavy oil and a two-stage air supply. Exhaust velocity is about 100 m/s. Tests have been going on for two years with two different sized burners, combusting 25 and 200 l oil/h.

19221 **High velocity fluid beds.** Weinstein, H. (City Univ. of New York, NY); Yerushalmi, J. pp 167-178 of Advances in coal utilization technology. Chicago, IL; Institute of Gas Technology (1979).

From Institute of Gas Technology symposium: advances in coal utilization technology; Clarksville, IN, USA (14 May 1979).

As a result of City College work supported by US DOE it was concluded that: (1) as the velocity of the gas flowing across a bubbling fluidized bed is raised, the heterogeneous character of the bed peaks, and then gradually changes to a condition of increasing uniformity marking transition to the turbulent state in which large bubbles or voids are on the whole absent; (2) the transition from bubbling to turbulent fluidization is reflected in the fluctuations of both the dynamic pressure at any point in the bed and the pressure drop across the bed; (3) the ratios U/sub c/U/sub T/ and U/sub k/U/sub T/ (where U/sub T/ is the terminal velocity of the median particle) approach or even exceed 10 for beds of fine powders; they diminish with particle density and size, and could become less than unity for beds of coarse solids. The large ratios for fine powders arise from their tendency to cluster; (4) the turbulent regime extends to the transport velocity which marks the onset of concurrent transport flow of gas and solid. The transport velocity may be viewed as the boundary which divides vertical gas-solid flow regimes into the stationary states and the transport regime which encompasses a wide range of states from dilute phase flow to the fast bed condition. The latter is typically achieved at gas velocities just beyond the transport velocity by providing sufficiently high solid circulation rates; (5) the fast bed condition is marked by relatively high solid concentration, the presence of relatively large aggregates and clusters of particles, extensive refluxing of solid, and slip velocities that are typically an order of magnitude greater than the free-fall velocities of the individual particles.

UNDERGROUND ENGINEERING

REFER ALSO TO CITATION(S) 18950, 18954, 18956, 18957

19222 (CONF-7805138—P1) **Earth-covered buildings: technical notes.** Moreland, F.L.; Higgs, F.; Shih, J. (eds.). (Texas Univ., Arlington (USA); Louisiana State Univ., Baton Rouge (USA)). 1978. Contract W-7405-ENG-26. 287p. Dep. NTIS, PC A13/MF A01.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

John Cable, Architectural and Engineering Systems Branch, Division of Buildings and Community Systems, Department of Energy, kicked off the conference and spelled out the role of DOE in this area. One of his points was that the technical problems are easier than the institutional problems. A separate abstract was prepared for each of the 18 papers of this volume; all of the abstracts will appear in Energy Research Abstracts (ERA), and 16 were selected for Energy Abstractss for Policy Analysis (EAPA). (DCK)

19223 (CONF-7805138—P1, pp 1-12) **Earth-covered structures.** Kommendant, A.E. 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

Several designs suitable for underground structures are presented to demonstrate that economics and ease of construction do not have to be obstacles. Underground fuel storage tanks, for example, are safer and would be more acceptable in urban areas. A slipform method of tank construction, positioned under a concrete dome, can use some of the same structural systems developed for underground parking facilities. Tied-arch construction is the safest and least-expensive design for underground factories, while elliptic paraboloid shells are suitable for public buildings. Buildings that are above grade can have flat roofs with gardens built on a two-way Vierendeel system, which carries the heavy load to supporting columns. 15 figures. (DCK)

19224 (CONF-7805138—P1, pp 13-33) **Soil-structure interaction: an overview.** Flathau, W.J.; Balsara, J.P. (Army Corps of Engineers, Vicksburg, MS). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

An overview is given of laboratory tests made by the Corps of Engineers at the Waterways Experiment Station (WES) on soil-structure interaction relevant to earth-covered systems. A series of studies and models confirm that soil-structure systems provide both insulating and structural advantages. Summaries of six pressure tests illustrate the importance of geometric design, although the surrounding soil is shown to assume much of the load-carrying capability. Future studies in interface stresses, weather-related stresses, and arching are recommended. 6 references, 18 figures. (DCK)

19225 (CONF-7805138—P1, pp 34-44) **Earth pressures on shallow buried structures.** Quigley, D.W. (Harding-Lawson Associates, Houston, TX); Duncan, J.M. 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

The factors that determine the earth pressures on shallow buried structures are shown to be fairly simple and well understood. Through thorough site investigations to determine soil types, groundwater conditions, structure movements and surface loads, and the use of simple theories and field data, design earth pressures can be estimated that will result in safe and economical designs for buried structures at suitable sites and the identification of sites where their use is not suitable. If enough money is available, a safe building design can be achieved regardless of the site conditions. However, if the intent of burying a structure is to reduce operational costs such as energy consumption, it is essential to insure that the potential savings are not lost during construction of the facility because of excessive structure costs or unanticipated construction problems. 6 figures.

19226 (CONF-7805138—P1, pp 45-59) **Economical structural and footing Considerations for buried structures.** True, D.G. (Naval Construction Battalion Center, Port Hueneme, CA). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

The usual functional and structural objectives of structures in general, and those specific to the user's needs, must be satisfied for any buried structure to be considered viable. Buried structures inherently satisfy the special objectives of energy conservation and environmental compatibility. Variations in economy may be realized, however, because of the materials, structural configuration, and details selected. The available materials and feasible configurations for meeting the imposed conditions of loading, support, buoyancy, ground motion, ground water percolation, and deteriorative agents are examined in this context, and specific recommendations are made. 7 references, 4 figures, 2 tables.

19227 (CONF-7805138—P1, pp 60-69) **Structural systems for earth-sheltered housing.** Sterling, R. (Underground Space Center, Minneapolis, MN). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

The major considerations affecting the selection and design of structural systems for earth-sheltered housing are summarized in terms of how well existing structural systems satisfy these considerations. The potential of the various structural systems is examined, and promising research areas are identified.

19228 (CONF-7805138—P1, pp 70-73) **Structural problems in earth-covered buildings.** Darvas, R.M. (Univ. of Michigan, Ann Arbor). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

Earth-covered structures introduce special structural engineering problems, all of which have been dealt with over the network of underground structures supporting cities. The weight of earth-covered roofs, lateral pressures on the walls, and hydrostatic forces on the floors are peculiar to underground construction. The weatherproofing envelope is critical to the success of the building and warrants strict quality control. Excavating and retaining the soil of adjacent buildings and dewatering the site are major construction problems that respond well to new techniques using prestressed tiebacks. The new University of Michigan Law School Library incorporates many of the new structural techniques as well as meeting a number of aesthetic requirements. (DCK)

19229 (CONF-7805138—P1, pp 74-91) **Concrete for earth-covered structures.** McDonald, J.E.; Liu, T.C. (Army Engineer Waterways Experiment Station, Vicksburg, MS). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

Earth-covered buildings, like many other structures, are constructed of concrete because that is accepted by engineers as the most economic and satisfactory building material. The proportion of cement, aggregates, water, and admixtures determines the concrete's properties, which can be varied to meet specific requirements. Permeability testing to locate defects or conditions that influence leakage through the concrete and the effects of the major components are described. A variety of concrete surface coatings is available to insure against leakage caused by poor workmanship or bad luck and is more effective when applied to the surface in contact with soil or water. Several varieties of concretes have been developed for specialized applications, such as the polymer-impregnated concrete used for bridge and tunnel repair. 39 references, 7 figures, 3 tables.

19230 (CONF-7805138—P1, pp 92-114) **Optimization of earth-covered shell structures.** Shih, J.C. (Louisiana State Univ., Baton Rouge). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

The optimization of the earth-covered shells requires that the shape and the thickness distribution of the shell for loads corresponding to the two different depths be determined in such a way that the resulting stresses in the shell are constant and compressive everywhere. This is a rather complex problem because there are several coupled unknowns, including the shape of the shell, the earth load exerted on it, and the variable-thickness distribution. For this reason, the problem is not considered tractable for the case of plastic deformation and for shells with bending. Therefore, a possible attack on this problem can be made by elastic analysis and membrane theory to permit some decoupling of the unknowns discussed above. The analysis to determine the optimum shape of these earth-covered shells is an inverse approach to the usual design problem of shells. For the usual shell design situations the shape of the shell is specified, and the shell is designed such that the stresses at any point do not exceed a permissible working stress assumed to be acting everywhere in the shell. The problem then reduces to determining the shape and thickness variation for the prescribed earth loads, so that the assumption of constant stress in the shell is not violated anywhere. 15 references, 11 figures.

19231 (CONF-7805138—P1, pp 115-122) **Literature review on the structural optimization for the possible application of earth-covered buildings.** Shih, J.C. (Louisiana State Univ., Baton Rouge). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

A complete literature review of all the structures or shells is not attempted here. Nash (Taylor Model Basin Report TMB-1863(1954)) lists over 1450 publications written before 1953 only on shells and shell-like structures. In as much as publications in this field have greatly accelerated in recent years, only a review of the highlights in minimum-weight design of structures and limit analysis of shells, and configuration of shells and shell-like structures under constant strength is presented here. To summarize this literature review, it may be observed that previous investigators have presented the optimum design approach of the determination of structures in many fields of mechanics. Contributions in optimization of building structures suitable for human occupation have been few. For the purpose of economy, the optimum design of subsurface and under-

ground structures is considered a very worthwhile and new solution for the benefit of mankind. 52 references.

19232 (CONF-7805138—P1, pp 123-138) **Modifying the ambient temperature of underground buildings.** Givoni, B. (Ben-Gurion Univ. of the Negev, Beersheba, Israel). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

The combination of thermal conductivity, which is affected by water content, and heat capacity determines the earth's Thermal Time Constant (TTC) and its point of temperature stabilization. Occupied underground structures generate heat, which flows to the surrounding earth mass by conduction and convective heat transfer, and are ventilated. Several options are described for elevating or lowering the level of stabilization so that comfortable temperature are achieved in any season. A covering of exposed crushed stones is applicable in desert areas or when land is limited. If an earth covering is used, the capacity to modify temperatures is largely dependent on the thickness of the covering. Several strategies are described for enhancing the affect by air flow. 7 figures. (DCK)

19233 (CONF-7805138—P1, pp 139-170) **Numerical procedures for the simulation of thermal environments in earth-covered structures.** Emery, A.F.; Heerwagen, D.R.; Kippenhan, C.J.; Varey, G.B. (Univ. of Washington, Seattle). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

Earth covered structures are known to be capable of reducing large annual and diurnal air-temperature variations and the effects of strong variations in solar insolation. However, the practical use of such structures depends upon an ability to predict the thermal response of such buildings, since such unusual working and living spaces will require modification of the usual conditioning and lighting and control systems. It is recognized that, because of the large envelope thickness, a full three-dimensional thermal analysis may be necessary. In this paper it is shown that under normal weather conditions, a simpler one-dimensional thermal analysis will suffice. Using the energy analyzer, UWENSOL, a comparison is given between a conventional structure and two earth-covered structures during summer and winter periods and the difference in thermal response and the savings in energy consumption associated with the earth-covered structures are discussed. 7 references, 15 figures, 4 drawings.

19234 (CONF-7805138—P1, pp 171-194) **Earth-covered residential concept for the humid continental region.** Chester, C.V.; Shapira, H.B.; Barnes, P.R.; Cristy, G.A. (Oak Ridge National Lab., TN). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

An earth-covered structure with passive solar heating and natural cooling features can provide significant energy savings. The Oak Ridge National Laboratory (ORNL) is studying an earth-covered residential concept which addresses some of the special problems associated with the humid continental region. The advantages of the concept as well as some of the problem areas are discussed.

19235 (CONF-7805138—P1, pp 195-204) **Underground-solar house wind-tunnel test.** Hylton, J. 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

Wind-tunnel tests were conducted on a scale model of an underground-solar house to determine the optimum siting orientation and design configuration for both passive and active solar heating and natural ventilation for cooling. The test results are tabulated to show the pressure coefficient differences in various window locations according to wind direction and building configuration. These data are then used to determine the ideal air flow through the house and to design wind tower arrangements which will achieve the goal of energy self-sufficiency. 2 tables. (DCK)

19236 (CONF-7805138—P1, pp 205-209) **Earth temperature: its effect on underground residences.** Davis, W.B. 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

The energy-saving potential of underground buildings is verified by an independent study of the dampening effect of earth on the thermal oscillations from changes in the ambient temperatures. The earth covering provides an inherent time lag because of the insulating capacity of the soil, which is inconsequential at depths less than three feet, and the slowness with which temperature changes are transmitted through the mass of soil, which is 90 days at an 8- to 10-foot depth. Comparisons were made of a house of standard construction and one of concrete nine feet below grade, using temperature measurements from a bomb-storage facility to determine the Btu requirements and costs of each. The area devoted to glazing was found to be the most significant factor. (DCK)

19237 (CONF-7805138—P1, pp 210-219) **Fire-safety characteristics of earth-covered dwellings.** Munson, M.J. (Princeton Univ., NJ). 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

The fire-safety implications of a community of underground houses are examined with a focus on the human and property losses from residential fires in comparison to the losses from conventional housing fires. Although the characteristics of earth-covered houses make them virtually fireproof except for the furnishings, most residential fires can be traced to the behavior of occupants and this will make the risks comparable for both types of construction. The need for fire-protection services will remain about the same, but there will be an additional problem of access with fire-fighting equipment and water to suppress underground fires. If underground houses are carefully designed for access and ventilation and are furnished with fire-resistant materials and warning devices, the energy-saving possibilities of underground communities should outweigh the fire hazards. 7 references. (DCK)

19238 (CONF-7805138—P1, pp 220-225) **Thermal chimneys and natural ventilation.** Orlouski, H. 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

The general rules for the adequate ventilation of underground buildings are reviewed in terms of proper design selection. Thermal chimneys that convey air to a point above the building should be designed and constructed to produce the required draft. A chart is used to plot height and cross-sectional area of the chimney against air movement as a guide in developing the appropriate pressure distribution. 3 figures. (DCK)

19239 (CONF-7805138—P1, pp 226-250) **Energy exchange between earth-sheltered structures and the surrounding ground.** Eckert, E.R. (Univ. of Minnesota, Minneapolis); Bligh, T.P.; Pfender, E. 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

A program of measurements is underway at Williamson Hall, an earth-sheltered building on the campus of the University of Minnesota. Continuous measurements of the temperature and the moisture field in the ground adjacent to the building, as well as the heat flux through the building walls, are recorded on magnetic tape and are thus available for evaluation. The thermal conductivities of soil samples at various moisture contents were measured with a novel unsteady method. Temperature fields in the soil adjacent to the building were also calculated on an electronic computer using the unsteady heat conduction equation. The paper describes the present status of this study and presents samples of the results obtained to date. 7 references, 15 figures, 1 table.

19240 (CONF-7805138—P1, pp 251-272) **Where to insulate earth-protected buildings and existing basements.** Bligh, T.P. (Massachusetts Inst. of Tech., Cambridge); Shipp, P.; Meixel, G. 1978.

From Earth covered settlements; Fort Worth, TX, USA (17 May 1978).

The capacity of underground buildings to conserve energy by reducing heat transfer between the structure and it surroundings is compared with the heat losses and gains of conventional aboveground structures. The contribution of window, wall, and roof insulation is evaluated as well as weather-related factors. The comparative data are based on houses in Minneapolis, Minn., 44°N latitude, during the summer and winter seasons. Design plans and net-energy calculations are made for several combinations of insulating materials. 5 references, 12 figures. (DCK)

POLLUTION CONTROL EQUIPMENT

19241 (ANL/EES-TM—76) **Review of Individual Technology Assessment Reports (ITAR) for industrial boiler applications.** Archer, T.; Bakshi, P.; Weisenberg, I.J. (Pacific Environmental Services, Inc., Santa Monica, CA (USA)). Jan 1980. Contract W-31-109-ENG-38. 81p. Dep. NTIS, PC A05/MF A01.

Eight Individual Technology Assessment Reports and one Background Study in Support of New Source Performance Standards for Industrial Boilers are reviewed. These ITARs were prepared for the EPA and include studies of particulate control, flue-gas desulfurization, fluidized-bed combustion, NO/sub x/ combustion modification, NO/sub x/ flue-gas treatment, coal cleaning, synthetic fuels, and oil cleaning. The ITARs provide engineering and cost data for the air pollution control technologies that will be required to meet the New Source Performance Standards for industrial boilers. The pollutants considered were SO/sub x/, NO/sub x/, and particulates. Each ITAR is reviewed from the standpoint of engineering, demonstrated technology, and costing methodology. The cost review includes a comparison of the costing methodology of

each ITAR with the costing methodology recommended by the EPA background document.

19242 (EPA—600/7-79-246) **Ceilcote ionizing wet scrubber evaluation.** Ensor, D.S. (Meteorology Research, Inc., Altadena, CA (USA)). Nov 1979. 89p. NTIS.

The Ceilcote ionizing wet scrubber installed on a refractory brick kiln was evaluated with tests involving particulate mass emission, particle size distribution, and opacity. The overall efficiency was 93% with an average outlet opacity determined with a heated plant process visiometer (PPV) of 8% over a 1.68 m (5.5 ft) path length. The average particle cut diameter of the scrubber system was 0.5 micron. The estimated theoretical power requirement for the ionizing wet scrubber was 41 w/am^3 (1.54 hp/1000 ACFM). However, the scrubber system developed for the kiln included a cooling tower to provide chilled water for the prescrubber to condense volatile emissions which required 26 w/am^3 (2.5 hp/1000 ACFM). The performance of the ionizing wet scrubber, based on theoretical power input, exceeds that of a venturi scrubber. It is recommended that the ionizing wet scrubber be considered in applications where practical for the removal of fine particulate matter.

19243 (PB—80-801418) **Air pollution control using particle filtration (a bibliography with abstracts). Report for 1964-November 1979.** Cavagnaro, D. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 182p. NTIS PC N01/MF N01.

The citations discuss technology, equipment design and performance, ultrafiltration, and size distribution factors. Aerosol and dust filtration are included. Studies on electrostatic precipitators have been excluded. (This updated bibliography contains 173 abstracts, 54 of which are new entries to the previous edition.)

POWER CYCLES

RANKINE

REFER ALSO TO CITATION(S) 18634

19244 (DOE/ET/12434—T1) **Multi-Megawatt Organic Rankine Engine power plant (MORE). Phase IA final report: system design of MORE power plant for industrial energy conservation emphasizing the cement industry.** Bair, E.K.; Breindel, B.; Collamore, F.N.; Hodgson, J.N.; Olson, G.K. (Aerojet Energy Conversion Co., Sacramento, CA (USA)). 31 Jan 1980. Contract AC03-78ET12434. 94p. Dep. NTIS, PC A05/MF A01.

The Multi-Megawatt Organic Rankine Engine (MORE) program is directed towards the development of a large, organic Rankine power plant for energy conservation from moderate temperature industrial heat streams. Organic Rankine power plants are ideally suited for use with heat sources in the temperature range below 1100°F. Cement manufacture was selected as the prototype industry for the MORE system because of the range of parameters which can be tested in a cement application. This includes process exit temperatures of 650°F to 1110°F for suspension preheater and long dry kilns, severe dust loading, multi-megawatt power generation potential, and boiler exhaust gas acid dew point variations. The work performed during the Phase IA System Design contract period is described. The System Design task defines the complete MORE system and its installation to the level necessary to obtain detailed performance maps, equipment specifications, planning of supporting experiments, and credible construction and hardware cost estimates. The MORE power plant design is based upon installation in the Black Mountain Quarry Cement Plant near Victorville, California.

PARTICLE ACCELERATORS

REFER ALSO TO CITATION(S) 19640, 19641

DESIGN, DEVELOPMENT, AND OPERATION

REFER ALSO TO CITATION(S) 19758

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

19245 **Method and means for measurement and control of pulsed charged beams.** Lewis, R.N. US Patent Application 003,561. [nd]. 18p.

A beam of bunches of charged particles is controlled by generating a signal in response to the passage of a bunch and adding to that signal a phase-flipped reference signal. The sum is amplified, detected, and applied to a synchronous detector to obtain a comparison of the phase of the reference signal with the phase of the signal responsive to the bunch. The comparison provides an error signal to control bunching.

19246 (LA—8287-MS) **Space-charge limit for an alternating-phase-focusing structure.** Inagaki, S. (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 15p. Dep. NTIS, PC A02/MF A01.

In a report titled Space-Charge Limit for a Drift-Tube Linac from the Stability Point of View of Longitudinal Periodicity, the author showed that the stability condition for the longitudinal periodicity gives one of the upper limits and sometimes a lower limit for a drift-tube linac. The same method can be extended to an alternating-phase-focusing (APF) structure to determine the optimum parameters and also the current limit. Using the space-charge expression of Vlasov, the current limit for the Pion Generator for Medical Irradiation (PIGMI) APF structure is found.

19247 (SLAC—226) **Electron trajectory program.** Herrmannsfeldt, W.B. (Stanford Linear Accelerator Center, CA (USA)). Nov 1979. Contract EY-76-C-03-0515. 119p. Dep. NTIS, PC A06/MF A01.

The SLAC Electron Trajectory Program is described and instructions and examples for users are given. The program is specifically written to compute trajectories of charged particles in electrostatic and magnetostatic focusing systems including the effects of space charge and self-magnetic fields. Starting options include Child's Law conditions on cathodes of various shapes. Either rectangular or cylindrically symmetric geometry may be used. Magntic fields may be specified using arbitrary configurations of coils, or the output of a magnet program such as Poisson or by an externally calculated array of the axial fields. The program is available in IBM FORTRAN but can be easily converted for use on other brands of hardware. The program is intended to be used with a plotter whose interface the user must provide.

19248 (UCID—18584) **Modeling of beam focusing and kink instability for colliding relativistic electron and positron beams.** Fawley, W.M.; Lee, E.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Feb 1980. Contract W-7405-ENG-48. 23p. Dep. NTIS, PC A02/MF A01.

A simulation code has been developed and exercised to study the time evolution and resultant liminosity of intersecting pulses of electrons and positrons. Under the extreme conditions of high current and small radius recently proposed for the SLAC facility, the pulses mutually pinch to a smaller mean radius than that achieved by free flight alone. The effective luminosity is enhanced by a factor of $\sim$ 3 in the best case, corresponding to zero initial emittance and pulse length equal 1/4 the mean betatron wavelength. Gaussian profiles in the longitudinal and transverse coordinates are preferred over flat profiles in order to minimize disruptive oscillations in radius which reduce luminosity. A second potential source of disruption is the kink instability. This is always present to some degree during the interaction of opposed pulses. However, the maximum growth rate is only one half the angular betatron frequency and therefore mode growth is limited to a very low level if the pulses are short compared with a betatron wavelength.

19249 (UCRL-Trans—11564) **Spherical aberration of some rotationally symmetrical electrostatic lenses for large-aperture beams.** Septier, A. (Paris-1 Univ., 75 (France)). Aug 1978. Translation of CERN—60-39, 13 October 1960. 70p. Dep. NTIS, PC A04/MF A01.

The static accelerator used for injecting 500 keV protons into the CERN linear accelerator consists of an hf ion source with a very high output and an acceleration column with a homogeneous field, and includes a rotationally symmetrical electrostatic focusing lens between these two elements. The diameter of the beam at the exit from this accelerator depends on the geometric magnification of the optical system formed by the lens and the acceleration tube; the defocusing effect of the space charge of the beam, more pronounced the greater the intensity; the aberrations of the optical system and in particular, the aperture aberration of the focusing lens. For intense beams (20 to 50 mA), the angular aperture of the beam emerging from the exit diaphragm of the source may reach 20 to 30° at the entrance to the lens, despite an energetic preacceleration, and the aperture aberration is substantial. The aim of this work was to measure the aperture aberrations of various lenses used on the CERN accelerator, then to investigate lenses with slight aberrations. The work was carried out during 1958 and 1959 on a corpuscular optics bench described in a preceding report.

AUXILIARIES AND COMPONENTS

ION SOURCES

REFER ALSO TO CITATION(S) 19760

EXPERIMENTAL FACILITIES AND EQUIPMENT

19250 (BNL—27216) **Optimizing the design of very high power, high performance converters.** Edwards, R.J.; Tiagha, E.A.; Ganetis, G.; Nawrocky, R.J. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract EY-76-C-02-0016. 12p. (CONF-800335—1). Dep. NTIS, PC A02/MF A01.

From 7. national solid state power conversion conference and exhibit; San Diego, CA, USA (25 Mar 1980).

This paper describes how various technologies are used to achieve the desired performance in a high current magnet power converter system. It is hoped that the discussions of the design approaches taken will be applicable to other power supply systems where stringent requirements in stability, accuracy and reliability must be met.

19251 (KEK—78-7, pp 1-3) **Radiation protection shielding design goals for KEK.** Hirayama, H.; Katoh, K. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)); Thomas, R.H. Jun 1978.

In Studies on current problems of radiation shielding in KEK.

Two radiation protection design goals for shielding design are frequently used at KEK (Japan High Energy Research Laboratory). They are (1) a maximum dose equivalent rate of 1 mrem/hr at the surface of a shield, and (2) an annual dose equivalent rate of a few mrem/yr at site boundary. (The precise value is determined from considerations on the use of any facility in relation to other KEK sources of radiation). There is simple relation between these two design goals. Let Hs = maximum dose equivalent rate at shield surface (mrem/hr), and H sub(b) = maximum annual dose equivalent desired at site boundary (mrem/yr). Using the maximum neutron flux density at and the total effective source strength from the shield surface where a point source is assumed, the respective equations for the neutron flux density at site boundary, the site boundary dose equivalent rate, and the annual dose equivalent were derived, and substituting typical values, the ratio of H sub(s)/H sub(b) = 20 was obtained, i.e. Hs (mrem/hr) = 20 H sub(b) (mrem/yr), and for point sources, the requirement that the dose equivalent rate be limited to 1 mrem/hr at shield surface will maintain the annual site-boundary dose equivalent to 5×10^{-2} mrem.

19252 (KEK—78-7, pp 4-6) **Transverse shielding for point-like radiation sources at KEK.** Hirayama, H.; Katoh, K. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)); Thomas, R.H. Jun 1978.

In Studies on current problems of radiation shielding in KEK.

From a point source of neutrons, the maximum flux density at shield surface is given as a function of proton beam repetition rate, beam intensity per pulse, differential cross section for production of neutrons with energy greater than 150 MeV at 90 deg to a target, distance from the target to inner surface of the shield, thickness of the shield, number of mean free paths in the shield and factor which converts high energy flux density to total flux density. Also the effective neutron source leaking from the shield roof and the neutron flux density due to "sky-shine" at a distant point from the source, the dose equivalent rate at site boundary, the annual dose equivalent at the site boundary and the shielding thickness required are in turn presented using spectrum build-up factor, distance of the point from the source, attenuation length of high energy neutrons in air, number of hours operated per year, etc. The equation for the shielding thickness required is finally given by substituting the numerical values of the spectrum build-up factor, flux density conversion factor, the neutron flux density due to "sky-shine" conversion factor in n/cm^2 sec per mrem/hr, and the attenuation length of high energy neutrons in air in cm.

19253 (KEK—78-7, pp 47-68) **Shielding calculation for the KEK photon factory.** Hirayama, H. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jun 1978.

In Studies on current problems of radiation shielding in KEK.

Shielding calculation for the photon factory which will be constructed in KEK is presented. The factory is a facility composed of a 2.5 GeV electron linac and a 2.5 GeV storage ring. Design criteria used in the shielding calculation were set for the annual dose equivalent at the site boundary, maximum value of the dose equivalent rate on the shield surface and the spatial dose equivalent rate outside the radiation controlled area. The intensity of electron beam of the linac is 500 mA at the peak with 1 μsec width at the maximum energy of 2.5 GeV. The linac is designed to be used also as an injector in the TRISTAN project, and will be operated with 50 Hz repetition rate in case of TRISTAN project. The storage ring is essentially elliptical in shape, and the injection efficiency from the linac to the storage ring is estimated to be 10 percent. Shielding calculations both for the linac and for the storage ring were made by the method based on PEP note 106 and PEP-215. The intensities of both photon and neutron sources are assumed to be proportional to the electron energy. Shielding calculation can be done by the O'Brien's method, and the result was compared with the PEP method. The variation of maximum dose equivalent rate was calculated by the PEP method at the 2 GeV slit. It was found that heavy concrete is good as the shielding material at the slit place. Designed shield thickness and the corresponding maximum dose equivalent rate are shown in a table. Annual dose equivalents at two points at the site boundary are obtained.

19254 (KEK—78-7, pp 15-28) **Transverse shielding for KENS, 2.** Thomas, R.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1978.

In Studies on current problems of radiation shielding in KEK.

This note describes on calculation of the transverse (overhead) shielding required for the KEK (Japan High Energy Research Laboratory) Intense Neutron Source (KENS). It is an unfortunate fact that the literature on radiation shielding at this energy are confusing. In view of these uncertainties, two methods of calculation are presented: calculation based on measurement of the neutron yield from thick uranium targets bombarded by 740 MeV protons, and scaling upwards calculation of the transverse shielding for proton linear accelerators with energy up to 200 MeV. Two radiation design goals are used at KEK: a maximum dose equivalent rate of 1 mrem/hr at shield surface and a total accelerator produced contribution of 5 mrem/year at the site boundary of the laboratory. The note describes about values of the parameter assumed, and values concerning shielding calculation models. Model 1 predicts total shield thickness of 1920 gm/cm^2 to achieve the radiation intensity of 1 mrem/yr on the shield roof. However, Model 1 overstimates the shield thickness because the data of Madey et al. of 740 MeV protons were taken, and revised to 1860 gm/cm^2. Similarly Model 2 underestimates the shield because the target material assumed in O'Brien's calculation is copper/iron. If high energy neutron yield is scaled by the mass numbers of targets, the thickness of 1880 gm/cm^2 is obtained. Thus, Model 1 and Model 2 predict values of 1860 and 1880 gm/cm^2, respectively. These values are in fortuitously good agreement. The shield should be constructed with heavy concrete and iron.

19255 (KEK—78-7, pp 69-85) **Shielding calculations for the KEK slow extracted beam facility.** Thomas, R.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1978.

In Studies on current problems of radiation shielding in KEK.

The calculation presented in this note is check of the dose equivalent rate to be expected outside the shield surface of the 12 GeV KEK proton synchrotron, of which the intensity of protons is 10^{12} per sec. Design goal of the radiation shielding is set to be no more than 5 millirem per year at the site boundary. The upper limit of the dose equivalent rate on the shield surface shall be 1 millirem per hour. The calculation of dose equivalent rate reported in this paper utilized the empirical data from Rutherford Laboratory and Argonne National Laboratory. Relation between the dose equivalent rate on the shield surface and the beam power was used for estimation. Dose rates at various points along the beam path were calculated. As a result, it can be said that no serious radiation intensity is to be expected outside the shielding planned for the slow extracted proton beam facility.

19256 (UCID—18582) **Microwave measurements of the ETA accelerating cavity.** Birx, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Mar 1980. Contract W-7405-ENG-48. 32p. Dep. NTIS, PC A03/MF A01.

Microwave measurements of the ETA accelerating cavities have shown eleven resonances in the frequency range of 0 to 850 MHz. These modes have been identified according to their similarity with the modes of a cylindrical cavity. Measurements of the Q's of the modes yielded values from 14 to 70 and transverse shunt impedances (R/sub perpendicular/Q) of 9 to 12Ω. In particular, beam breakup mode (TM_{110}) has a Q of 20 to 40 and a transverse impedance of 9Ω. A later report will describe proposed modifications to the cavity for the ATA accelerator that reduce the Q's substantially.

INSTRUMENTATION

RADIATION INSTRUMENTATION

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 18479, 19172, 19865

19257 Radiation detection system. Whited, R.C. US Patent Application 029,964. [nd]. 17p.

A system for obtaining improved resolution in relatively thick semiconductor radiation detectors, such as HgI_2, which exhibit significant hole trapping. Two amplifiers are used: the first measures the charge collected and the second the contribution of the electrons to the charge collected. The outputs of the two amplifiers are utilized to unfold the total charge generated within the detector in response to a radiation event.

19258 Improved gas mixtures for gas-filled particle detectors. Christophorou, L.G.; McCorkle, D.L.; Maxey, D.V.; Carter, J.G. US Patent Application 005,263. [nd]. 7p.

Improved binary and tertiary gas mixture for gas-filled particle detectors are provided. The components are chosen on the basis of the principle that the first component is one gas or mixture of two gases having a large electron scattering cross section at energies of about 0.5 eV and higher, and the second component is a gas (Ar) having a very small cross section at and below about 0.5 eV; whereby fast electrons in the gaseous mixture are slowed into the energy range of about 0.5 eV where the cross section for the mixture is small and hence the electron mean free path is large. The reduction in both the cross section and the electron energy results in an increase in the drift velocity of the electrons in the gas mixtures over that for the separate components for a range of E/P (pressure-reduced electron field) values. Several gas mixtures are provided that provide faster response in gas-filled detectors for convenient E/P ranges as compared with conventional gas mixtures.

19259 (BNL—26869) **Centroid finding method for position-sensitive detectors.** Radeka, V.; Boie, R.A. (Brookhaven National Lab., Upton, NY (USA)). Oct 1979. Contract EY-76-C-02-0016. 21p. (CONF-791037—25). Dep. NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; San Francisco, CA, USA (17 Oct 1979).

A new centroid finding method for all detectors where the signal charge is collected or induced on strips of wires, or on subdivided resistive electrodes, is presented. The centroid of charge is determined by convolution of the sequentially switched outputs from these subdivisions or from the strips with a linear centroid finding filter. The position line width is inversely proportional to N/sup 3/2/, where N is the number of subdivisions.

19260 (CONF-790782—1) **Modified conjugate counting technique for quantitative measurement of radioactivity in vivo.** Tsui, B.M.W.; Chen, C.T.; Yasillo, N.J.; Ortega, C.J.; Charleston, D.B. (Chicago Univ., IL (USA). Dept. of Radiology; Franklin McLean Memorial Research Inst., Chicago, IL (USA)). 1979. Contract EY-76-C-02-0069. 24p. Dep. NTIS, PC A02/MF A01.

From 21. annual meeting of the American Association of Physicists in Medicine; Atlanta, GA, USA (29 Jul 1979).

This paper presents a modified conjugate counting method for studying biochemical transformations in health and disease, in making realistic radiation-absorbed dose estimates, and in developing clinical procedures indicative of abnormal functions. A new instrument design improves the accuracy to within 5%. (PCS)

19261 (LA-UR—80-878) **Application of the active well coincidence counter to the measurement of uranium.** Menlove, H.O.; Foley, J.E.; Bosler, G.E. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-800315—6). Dep. NTIS, PC A02/MF A01.

From 2. symposium of the European Safeguards Research and Development Association; Edinburgh, UK (26 Mar 1980).

An Active Well Coincidence Counter has been developed to assay uranium fuel material in field inspection applications. The unit is used to measure bulk UO_2 samples, high enrichment uranium metals, LWR fuel pellets, and ^{233}U-Th fuel materials which have very high gamma-ray backgrounds.

19262 Fast neutron spectrum measurement with threshold detectors. Moghari, M. Ames, IA; Iowa State Univ. (1979). 165p. University Microfilms Order No. 80-00,161.

Thesis (Ph. D.).

The neutron energy spectra were measured in two Ames Laboratory Research Reactor experimental facilities (the R-3 rabbit and the V-1 vertical thimble). Seventeen activation detectors were irradiated in the above facilities and the neutron induced activities were measured using a Ge(Li) detector and the peripheral equipment. The spectrum unfolding was performed by a modified SAND-II computer code with 100 energy groups. The errors were estimated with the aid of a SAND-II Monte Carlo error analysis code. Comparison of fast neutron spectral distributions for the two facilities yielded pronounced differences at energies between 0.10 to 1.8 MeV. The R-3 facility differential fluxes at 0.1, 0.5, 1.0, and 1.8 MeV were found to be 3.5×10^{14}, 1.7×10^{14}, 7.5×10^{12}, and 3.8×10^{12} n/cm^2 sec MeV, respectively. The corresponding figures for the V-1 facility were 3.0×10^{15}, 3.5×10^{14}, 9.4×10^{12}, and 4.4×10^{12} n/cm^2 sec MeV.

RADIATION DOSEMETERS

19263 New polycarbonate fast neutron personnel dosimeter. Sohrabi, M.; Morgan, K.Z. (Georgia Inst. of Tech., Atlanta). Contract AT-(40-1)4814. *Am. Ind. Hyg. Assoc. J.;* No. 39, 438-447(Jun 1978).

Registration of fast-neutron-induced recoil and (n,α) tracks directly in sensitive polymers expecially polycarbonate foils when etched by the electrochemical etching (ECE) method provides a simple, sensitive, and inexpensive means of fast neutron dosimetry. The wide dose range and a dose equivalent response, negligible fading rate, and insensitivity to X, beta, and gamma radiations make such a method feasible for many neutron dosimetry applications, especially personnel dosimetry. Due to very large size of the tracks, even the unaided eye can be used as a reading device.

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

19264 (COO—1198-1284) **Analytical transmission electron microscopy in materials science.** Fraser, H.L. (United Technologies Research Center, East Hartford, CT (USA)). 1980. Contract EY-76-C-02-1198. 16p. (CONF-800510—1). Dep. NTIS, PC A02/MF A01.

From International conference on pure materials in technology; Dresden, German Democratic Republic (May 1980).

Microcharacterization of materials on a scale of less than 10 nm has been afforded by recent advances in analytical transmission electron microscopy. The factors limiting accurate analysis at the limit of spatial resolution for the case of a combination of scanning transmission electron microscopy and energy dispersive x-ray spectroscopy are examined in this paper.

19265 (UCRL—84043) **X-ray zone plates fabricated using electron-beam and x-ray lithography.** Shaver, D.C.; Flanders, D.C.; Ceglio, N.M.; Smith, H.I. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.; California Univ., Livermore (USA). Lawrence Livermore Lab.; Massachusetts Inst. of Tech., Cambridge (USA)). 1979. Contract W-7405-ENG-48. 19p. (CONF-7905140—1). Dep. NTIS, PC A02/MF A01.

From 15. symposium on electron, ion and photon beam technology; Boston, MA, USA (May 1979).

Fresnel zone plate patterns, free of spherical abberation, with diameters of up to 0.63 mm and linewidths as small as 1000 A were fabricated on polyimide-membrane x-ray masks using scanning electron beam lithography Distortion of the electron beam scan raster was reduced to $<$ 2500 A over a 2 mm x 2 mm field by applying deflection corrections, while viewing the distortion using a moire method. C/sub k/ x-ray lithography was used to replicate the zone plate pattern in thick PMMA over a 100 A thick plating base on a glass substrate. Zones plates in 1.3 μm thick gold were fabricated by plating, and made free-standing by removal of the plating base and the supporting glass substrate. Zone plates were tested as imaging elements with visible light and soft x-rays.

HIGH ENERGY PHYSICS INSTRUMENTATION

19266 (COO—2310-7) **Approaches to analysis of data that concentrate near higher-dimensional manifolds.** Friedman, J.H.; Tukey, J.W.; Tukey, P.A. (Stanford Linear Accelerator Center, CA (USA); Princeton Univ., NJ (USA); Bell Labs., Murray Hill, NJ (USA)). 1979. Contract EY-76-S-02-2310. 8p. (CONF-7910136—1). Dep. NTIS, PC A02/MF A01.

From 2. international symposium on data analysis and informatics; IRIA, Versailles, France (17 Oct 1979).

The need to explore structure in high-dimensional clouds of data points that may concentrate near (possibly nonlinear) manifolds of lower dimension led to the current development of three new approaches. The first is a computer-graphic system (PRIM'79) that facilitates interactive viewing and manipulation of an ensemble of points. The other two are automatic procedures for separating a cloud into more manageable pieces. One of these (BIDEC) performs successive partitioning of the cloud by use of hyperplanes; the other (Cake Maker) explores expanding sequences of neighborhoods. Both procedures provide facilities for examining the resulting pieces and the relationships among them.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 18872, 18887, 19259, 19884

19267 Improved magnetic encoding device and method for making the same. Fox, R.J. US Patent Application 021,291. [nd]. 13p.

A magnetic encoding device and method for making the same are provided for use as magnetic storage media in identification control applications that give output signals from a reader that are of shorter duration and substantially greater magnitude than those of the prior art. Magnetic encoding elements are produced by uniformly bending wire or strip stock of a magnetic material longitudinally

about a common radius to exceed the elastic limit of the material and subsequently mounting the material so that it is restrained in an unbent position on a substrate of nonmagnetic material. The elements are spot weld attached to a substrate to form a binary coded array of elements according to a desired binary code. The coded substrate may be enclosed in a plastic laminate structure. Such devices may be used for security badges, key cards, and the like and may have many other applications. 7 figures.

19268 **Side-welded fast response sheathed thermocouple.** Carr, K.R. US Patent Application 003,558. [nd]. 5p.

A method of fabricating the measuring junction of a grounded-junction sheathed thermocouple to obtain fast time response and good thermal cycling performance is provided. Slots are tooled or machined into the sheath wall at the measuring junction, the thermocouple wires are laser-welded into the slots. A thin metal closure cap is then laser-welded over the end of the sheath. Compared to a conventional grounded-junction thermocouple, the response time is 4 to 5 times faster and the thermal shock and cycling capabilities are substantially improved.

19269 (GEPP-OP—491) **Fabrication of ultra-sensitive leak detection standards.** Winkelman, C.R. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 1980. Contract EY-76-C-04-0656. 16p. (CONF-800519—1). Dep. NTIS, PC A02/MF A01.

From American Vacuum Society New Mexico Chapter meeting; Santa Fe, NM, USA (6 May 1980).

The primary difficulty with flow rate measurements below 10^{-10} standard cubic centimeters per second (std. cc/sec) is that there are no commercially available standards. The requirements, however, dictate that the problem of design and construction of a qualifiable standard in the ultra-sensitive range had to be solved. There are a number of leak types which were considered - capillary leaks, orifice leaks, and the pore type leaks, among others. The capillary leak was not used because of the cracking or sorting effects that are common to this type leak. For example, a gas blend flowing through a capillary leak will result in the lighter gases passing through the leak first. The difficulty of fabricating the proper hole size in relation to the flow rate requirements ruled out the orifice type leak. The choice was the pore type leak which utilizes the basic concept of a stainless steel knife edge driven into a fixed section composed of stainless steel with a gold over-lay and maintained under force.

19270 (SAND—80-8004) **Data multiplex system for the dispensing station at the Tritium Research Laboratory.** Strout, R.E. (Sandia Labs., Livermore, CA (USA)). Mar 1980. Contract EY-76-C-04-0789. 20p. Dep. NTIS, PC A02/MF A01.

Throughout the Tritium Research Laboratory's dispensing station, pressure and temperature are monitored continuously. A multiplex system brings the data from the monitoring points to a central location for use in a programmable calculator. The system consists of a programmable calculator, a multiprogrammer, four address units, digital panel meters, and buffer units interfacing the meters with the rest of the components. This report describes how each component fits into the system to make it work.

19271 (SAND—80-8010) **Automation of a repetitive experiment applied to a thermogravimetric analyzer.** Burris, K. (Sandia Labs., Livermore, CA (USA)). Mar 1980. Contract EY-76-C-04-0789. 15p. Dep. NTIS, PC A02/MF A01.

To automate the recording of data from a thermogravimetric analyzer, a controller was designed to fetch instrument readings at specified time intervals and send the data to a teletype/paper-tape punch. Additional goals were to minimize cost, hardware design time, software development time, and debugging time. Project details, which can be applied to a general class of repetitive experiments that are common in a laboratory environment are described.

19272 (UCID—18569) **ARAC site terminal installation guide.** Lawver, B.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1980. Contract W-7405-ENG-48. 22p. Dep. NTIS, PC A02/MF A01.

This manual is designed for the site user to prepare the installation of the ARAC site terminal, one part of the Atmospheric Release Advisory Capability (ARAC). The installation requires support from Electronic Engineering, Plant Engineering, the telephone company, Purchasing, and finally Receiving. Each support group's effort is described, and an estimate of lead time is given. The major effort with the greatest lead time concerns the ARAC/site meteorological tower interface. Each site is assumed to possess a meteorological tower with wind and temperature measurements. ARAC requires an interface that transmits the digitized data to the site terminal. Such an interface has been built by several sites by utilizing micro-processor technology. The greatest delay experienced by the various sites has been the scheduling of a technician to build the interface. Once the technician started, the job proceeded quickly. Other tasks outlined by this guide may also delay operation, particularly if adequate lead-time is not scheduled. Later sections cover the Plant Engineering modifications required to locate and operate the site terminal, the information and equipment needed from the telephone company, the arrival of the crated material, and the hookup of cables and diagnostics that should be run. Also discussed are initial operation and several options for maintenance. 2 figures. (RWR)

19273 (UCID—18580) **Standing wave method of determining the resonant frequency of circuits involving low L and high C.** Graham, H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Mar 1980. Contract W-7405-ENG-48. 11p. Dep. NTIS, PC A02/MF A01.

Portions of document are illegible.

In the design of circuits where fast rising pulses of very high currents are desired, it has been difficult to determine the inductance of the capacitors and other circuit components involved. Due to the fact that, in order to make measurements, it has been necessary to add additional circuitry. This additional circuitry introduces serious errors that are difficult to evaluate. A method is described which is capable of determining the resonant frequency of L-C circuits involving inductances as low as .001 uH and net impedances as low as .001 ohm, provided the resonant frequency is below 15 mc. External circuitry does not effect the accuracy of measurement as this circuitry is not included in the parameters of the circuit being measured. It is possible to determine the effective resistance of the circuit being measured and thereby obtain the Q efficiency of the system.

19274 (UCRL—83931) **Block adaptive filtering.** Clark, G.A.; Mitra, S.K.; Parker, S.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.; California Univ., Santa Barbara (USA). Dept. of Electrical and Computer Engineering; Naval Postgraduate School, Monterey, CA (USA)). Feb 1980. Contract W-7405-ENG-48. 5p. (CONF-800421—1). Dep. NTIS, PC A02/MF A01.

From IEEE international symposium on circuits and systems; Houston, TX, USA (28 Apr 1980).

Block filtering implies the calculation of a block or finite set of filter outputs from a block of input values. A procedure for doing this with adaptive filters is developed along with analyses of convergence properties and computational complexity. It is shown that the block approach can offer advantages in convergence speed, accuracy and computational complexity over conventional adaptive filtering techniques under the proper circumstances.

19275 (Y/DW—39) **Microcomputerized instrument to detect the liquid-phase arrest temperature in sintering furnaces.** Mee, D.K.; Darby, D.M.; Sims, T.M. Jr. (Oak Ridge Y-12 Plant, TN (USA)). 1980. Contract W-7405-ENG-26. 5p. (CONF-800502—9). Dep. NTIS, PC A02/MF A01.

From 26. international instrumentation symposium; Seattle, WA, USA (5 May 1980).

A highly accurate temperature measurement is required in the sintering of certain alloys. A method previously used to obtain this accuracy over a limited range used W-3Re versus W-25Re thermocouples with a one-point calibration at the alloy's liquid-phase arrest temperature. Furnace operators were required to calibrate the system by observing the arrest temperature on a strip chart recorder and calculating a hold temperature for it. Since errors can easily be made in this process, a liquid-phase detection instrument (LPDI) has been developed to aid personnel by detecting the liquid-phase arrest temperature, alert personnel to procedural deviations, and make computer control of sintering furnaces possible.

WELL LOGGING INSTRUMENTATION

REFER ALSO TO CITATION(S) 18430, 18475

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

19276 (BNL—27150) **Effect of taggant vapor adsorption and containment on the pedetonation detection of explosives.** Senum, G.I.; Ferreri, E.M.; Greene, M.W.; Gergley, R.P.; Dietz, R.N. (Brookhaven National Lab., Upton, NY (USA)). Oct 1979. Contract EY-76-C-02-0016. 95p. Dep. NTIS, PC A05/MF A01.

Predetonation detection of explosives in realistic scenarios may be accomplished by detecting vapors emitted by the explosive. These vapors could be either the vapor emitted from the inherent compounds present in the explosive or the vapor emitted by a specific vapor taggant introduced into the explosive at the time of manufacture. The emitted vapor concentration in various detection scenarios can be diminished either by vapor adsorption onto adsorptive surfaces present in the scenario, e.g., clothing, curtains, rugs

etc., or by enclosing the explosive in a relatively airtight enclosure, e.g., box, luggage, etc., which will impede the vapor emission into the detection scenario. These two effects are modeled to ascertain the magnitude of the vapor concentration reduction in various scenarios. Experiments have been performed to provide a necessary input parameter for the containment model and to confirm the predictions of the model. Seven potential vapor taggants were experimentally examined for their vapor concentration depletion by adsorption in a typical scenario. The potential vapor taggants are perfluorodimethylcyclobutane (PDCB), perfluoromethylcyclohexane (PMCH), perfluorodimethylcyclohexane (PDCH), perfluorodecalin (PFD), L-4412 (a 3M Company proprietary compound), decafluorobiphenyl (DFBP), octafluoronaphtalene (OFN), and octafluorotoluene (OFT). Six enclosures were examined experimentally for their ability to contain taggant vapors. Of these, a box filled with styrofoam packing, a suitcase, a heat sealed polyethylene bag, and an attache case provided no significant impediment to the release of the vapor taggant into the detection scenario, i.e., these enclosures had a negligible degree of airtightness. The remaining two examined enclosures, a paint can and a zip lock plastic bag, showed significant vapor containment and thus possibly could hinder the vapor detection of explosives which are placed in these enclosures.

19277 (SAND—80-0344) **Pressure loading of aluminum and quartz using spray deposited light-initiated high explosive.** Benham, R.A. (Sandia Labs., Albuquerque, NM (USA)). Feb 1980. Contract EY-76-C-04-0789. 64p. Dep. NTIS, PC A04/MF A01.

A series of experiments was conducted for the purpose of evaluating the impulsive pressure loading generated at a material surface by the detonation of light-initiated high explosive on that surface. The explosive was sprayed and then detonated directly on both carbon and quartz pressure transducers. The output was recorded to allow determination of the characteristics of the pressure loading, as well as to evaluate the variability of this loading.

NUCLEAR

19278 (AD-A—068520) **HULL system guide. Final report.** Gaby, L.P. (Computer Sciences Corp., Albuquerque, NM (USA)). Jan 1979. Contract F29601-78-C-0012. 204p. NTIS, PC A10/MF A01.

HULL is a system of computer programs which solve the partial differential equations of continuum mechanics. It is used to solve problems in nuclear air blast and conventional weapon effects. The system is designed to tailor the program to be executed to fit the requirements of the problem and thus optimize the execution of the program. The three major functions performed by the system are the initialization of a problem (KEEL), calculating the time evolution of the problem (HULL), and plotting the results (PULL). The HULL system is currently operational on the CDC 6600 (Scope 3.4, NOS/BE), CDC Cyber 176 (NOS/BE, CDC 7600 (Scope 2.0), and IBM 370 (OS/VS2). (Author)

19279 (AD-A—074371/6) **Hydrogen, oxygen, water steam generator. Final report, 18 March 1977-15 October 1978.** Lagus, P. (Systems, Science and Software, La Jolla, CA (USA)). 15 Oct 1978. Contract DNA001-77-C-0188. 108p. NTIS PC A06/MF A01.

A prototype hydrogen, oxygen, water steam generating system has been developed. The system has been used to generate a modest amount of data relating to steam propagation through a packed sand column. A much larger capacity steam generating system based on the work completed appears to be possible.

19280 (LA-UR—80-620) **Applications of optical fibers in nuclear test diagnostics.** Lyons, P.B.; Hodson, E.K.; Looney, L.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 26p. (CONF-800322—1). Dep. NTIS, PC A03/MF A01.

From Defense Nuclear Agency meeting; Washington, DC, USA (25 Mar 1980/REPLACED BY CONF-800307).

Two new plasma diagnostic experiments have been successfully fielded on nuclear device tests at NTS. Both systems rely on the unique advantages provided by optical fiber technology and both systems provide new diagnostic capabilities that previously were beyond the state-of-the-art in coaxial cable systems. One system addresses the need to record e wide bandwidth data on gamma-ray sources. Over the long (< 1 km) distances that characterize NTS testing, the bandwidth of coaxial cable systems is usually limited to < 200 to 400 MHz even with extensive equalization. The new system uses the Cerenkov process to generate light in a converter material. High bandwidth fibers and detectors are used to approach a 1-GHz bandwidth. In this case fibers provided the bandwidth capability. The second system provides time and space resolution of a neutron source on a fast (ns) time scale. Previous systems have utilized either an array of neutron detectors with individual coaxial cables or a fast scintillator viewed by a gated image intensifier. For a large number of channels, the coaxial system becomes very costly and is subject to potentially severe EMI concerns. The gated intensifier system requires complex electronics and accurate timing and can be affected by EMI. An alternative system is described which provides continuous time coverage with limited spatial resolution. Complete freedom from EMI is achieved through the use of optical data collection and transmission. The optical fibers offered a major (2 to 3 times) cost savings and a large weight savings relative to the coax system. Each system is discussed.

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 19311, 19353, 19393, 19394, 19441, 19518, 19731

19281 (BNL—51098) **Data summary for evaluation of the transport and diffusion climatology of the United States east and Gulf Coasts.** Raynor, G.S.; Hayes, J.V. (Brookhaven National Lab., Upton, NY (USA)). Jul 1979. Contract EY-76-C-02-0016. 465p. Dep. NTIS, PC A20/MF A01.

A study of the atmospheric transport and diffusion climatology of the United States east and Gulf coasts was conducted as part of a larger coastal meteorology and diffusion program to aid in planning and site selection. Synoptic data were obtained from thirty coastal stations from Maine to Texas and analyzed in terms of conditions important to emission transport and diffusion. The thirty stations included four pairs with one of each pair at a greater distance from the coast than the other but near the same latitude. For each station, wind directions were classified into eight groups with reference to orientation of the local coastline. For some studies, these were combined into three groups - onshore, alongshore and offshore. Wind speeds were divided into four classes. A diffusion class for each observation was computed by a modified Pasquill method. This gave eight classes which were combined into three - unstable, neutral and stable - for some studies. A diffusion rating was derived from combinations of wind speed and diffusion class ranging from very good to very poor. Finally, the joint frequency distributions of wind direction and diffusion rating were calculated for each station. Data were then classified by season, time of day, wind direction, wind speed, diffusion class and combinations of these variables and the percent of hours in each subgroup determined. Results are presented in a series of tables.

19282 (CONF-7804163—(Vol.1), pp 289-296) **SPOT: the French trial earth observation system.** Gaubert, A.M. (Centre National d'Etudes Spatiales, Paris, France). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The French Government has decided to go ahead with a national Earth Observation System callet SPOT. The system, the satellite, and its payload for the first mission are described. Stress is put on certain new concepts.

19283 (CONF-7804163—(Vol.1), pp 513-521) **Global climate analysis utilizing remotely sensed data.** Sprigg, W.A. (National Oceanic and Atmospheric Administration, Rockville, MD). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The need to be aware of and to anticipate global climatic conditions has raised many new requirements of remote sensing technology and increased the importance of many commonly used remote sensing systems. Climate research and information services planned by the United States and by international organizations require new, improved, and expanded observation and monitoring capabilities to: maintain a current awareness of the climatic state and potential climate-affected resources; assess the potential of human activities to alter climate; and support research leading to accurate predictions of climate and the impacts of climate variability. In following these plans, and for a more thorough analysis of global climate, observations are needed of the atmosphere, oceans, earth radiation budget, hydrology and precipitation, and snow and ice masses of the world. Some requirements are for observations to support intensive studies of climate processes. Development of climate models requires observations over a range of time and space scales pertaining to seasonal, interannual, and decadal climate variability. Other requirements are for long-term monitoring of climate and climate-related parameters such as the temperature through the oceans' mixed layer, solar properties, and the CO_2 content of the atmosphere and rates of exchange with the oceans and land biomass. Remote sensing technologyy, it is hoped, will be developed to fill many of the anticipated data requirements.

19284 (CONF-7804163—(Vol.1), pp 535-546) **Acoustic radar and remote sensing in the boundary layer of atmosphere.** Nai-ping, L.; Hsi-an, F.; Nai-ping, L.; Shao-hou, C.; Yen-shuan, C. (Inst. of Atmospheric Physics, Academia Sinica, Peking, China). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Acoustic radar field observations were made in the countryside around Peking during three periods from December 1975 to November 1977. Information was obtained about the temperature structure of the atmospheric boundary layer in different seasons and under varying weather conditions. In addition the following parameters were studied: the height of the mixed layer; the formation and the dissipation of radiation inversion; the dimensions of the inversion layer and its various sections; gravity wave; and, thermal convection, etc. A method of measuring wind speed by acoustic radar is suggested; results are compared with observations made by pilot balloons. (JGB)

19285 (CONF-7804163—(Vol.1), pp 661-670) **Lidar remote sensing of lower atmosphere.** 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Laser radar techniques used for lower atmosphere remote sensing are discussed. Early major efforts were devoted to the development of LIDAR systems suitable for cloud base ranging and atmospheric parameter sounding. In recent years, more attention has been paid to applications, such as extinction coefficient detections in the lower atmosphere, industrial smoke plume dispersion, and visibility measurements. Several aspects of laser atmosphere research are reviewed briefly.

19286 (CONF-7804163—(Vol.2), pp 783-793) **Elimination of atmospheric effects from remote sensor data.** Turner, R.E. (Science Applications, Inc., Ann Arbor, MI). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Atmospheric effects frequently present problems in the analysis and interpretation of remote sensor data. The spatial and temporal variations in atmospheric haze can cause a decrease in the accuracy of classification of surface objects of interest. The haze, which is due to the aerosol component of the atmosphere, scatters and absorbs visible and infrared radiation as it passes from the scene on the ground to the sensor at some altitude above the Earth's surface. If one has some knowledge of the basic properties of the aerosol component then it is possible to remove the effects of the atmosphere prior to the actual data analysis. The pre-processing of the data in this context can be done by using an inversion algorithm, that is, a method which will transform the measured radiance at the sensor into a radiance or reflectance which is independent of the atmosphere. In this study the inversion algorithm, based upon radiative-transfer analysis, is described; and an example of its application to actual multispectral flight data is illustrated. The technique depends upon the availability of measured quantities rather than on statistical averaging used in the traditional methods of multispectral data analysis.

19287 (CONF-7804163—(Vol.2), pp 991-997) **Cloud effects on ultraviolet photoclimatology.** Green, A.E.S.; Spinhirne, J.D. (Univ. of Florida, Gainesville). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The purpose of this study is to quantify for the needs of photobiology the influence of clouds upon the ultraviolet spectral irradiance reaching the ground. Towards this end analytic formulas that approximately characterize the influence of clouds upon total solar radiation were developed. These may be used in conjunction with a solar pyranometer to assign an effective visual optical depth for the cloud cover. A formula that characterizes the influence of the optical depth of clouds upon the uv spectral irradiance in the 280 to 340 nm region was also developed. Thus using total solar energy observations to assign cloud optical properties, the uv spectral irradiance at the ground in the presence of these clouds can be calculated. As incidental by-products of this effort, convenient formulas for the direct and diffuse components of total solar energy were found.

19288 (CONF-7804163—(Vol.2), pp 999-1008) **Data screening and preprocessing for LANDSAT MSS data.** Lambeck, P.F.; Kauth, R.; Thomas, G.S. (Environmental Research Inst. of Michigan, Ann Arbor). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Two computer algorithms are presented. The first, called SCREEN, is used to automatically identify pixels representing clouds, cloud shadows, snow, water, or anomalous signals in LANDSAT-2 data. The second, called XSTAR, compensates LANDSAT-2 data for the effects of atmospheric haze, without requiring ground measurements or ground references. The presentation of these algorithms includes their theoretical background, algebraic details, and performance characteristics. Verification of the algorithms has for the present been limited to LANDSAT agricultural data. Plans for further development of the XSTAR technique are also presented.

19289 (CONF-7804163—(Vol.2), pp 1241-1257) **Atmospheric effects and their correction in airborne sensor and LANDSAT MSS data.** Kawata, Y.; Haba, Y.; Kusaka, T.; Terashita, Y.; Ueno, S. (Kanazawa Inst. of Tech., Ishikawa, Japan). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The apparent radiance of ground materials as measured by a remote sensor differs from the intrinsic surface radiance, because of the presence of the intervening atmosphere. One of the important consequences of the atmospheric effects is the blurring of the observed radiance map. Hence, the removal of the blurring should improve the accuracy of pattern recognition and image interpretation in remote sensing. It is shown how to evaluate the atmospheric blurring for the MSS digital data from air and space. Assuming the inhomogeneous hazy atmosphere bounded by the ground surface with horizontally non-uniform albedos, the procedures to evaluate the fraction of path radiance to the total radiance are described. In the case of aircraft data, the path radiance within the atmospheres and the scan angle effect is evaluated. Due to these complexities, a somewhat simplified averaging method is formulated. In the case of LANDSAT data, a convolution-type integral equation, relating the surface radiance distribution to the observed radiance map, is derived. This equation can be solved efficiently by means of the FFT algorithm. The correction procedures are applied to a MSS digital image obtained by the LANDSAT satellite, and also to one obtained by an aircraft. In the case of LANDSAT data, a sequence of atmospheric models is employed to examine the effect of varying the haze level. For the aircraft data, a correction based on the standard atmosphere is made. These results demonstrate the feasibility of the correction procedures in practical applications. Improvements due to the correction are more clearly seen for small (or thin) structures such as rivers and roads. This indicates the importance of atmospheric blurring, when one is concerned about the detailed ground structures in the analysis of remotely sensed earth's imagery.

19290 (CONF-7804163—(Vol.2), pp 1259-1266) **Estimating the proportions of classes in a boundary pixel.** Krishnan, R.; Natarajan, S. (National Remote Sensing Agency, Secunderabad, India). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The spatial resolution of the sensing device aboard a satellite is usually too limited for a variety of remote sensing applications. Because of this, some attempts have been made to estimate the proportions of different objects in a given (usually boundary) pixel. In particular, a certain previously reported maximum-likelihood estimator has been used to accomplish this. In this paper, a new simplified estimator is proposed, and its performance is experimentally shown to be similar to that of the maximum-likelihood estimator for the two class problem.

19291 (CONF-7804163—(Vol.2), pp 1529-1544) **Operational and experimental use of SMS/GOES digital satellite data.** Waters, M.P. III. (National Environmental Satellite Service, Washington, DC). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The geostationary meteorological satellites operated by the National Environmental Satellite Service (NESS) - the Synchronous Meteorological Satellite (SMS-2) and Geostationary Operational Environmental Satellite (GOES-2) - view the earth's disk through the Visible and Infrared Spin-Scan Radiometer (VISSR) instrument. Digital data from the VISSR on the eastern and western satellites are being processed in near real time into an experimental VISSR Data Base (VDB) on computer disk. Real time processing of the SMS/GOES digital satellite data by the NESS for both operational and experimental use/products is described. Examples of how these digital data are being currently used operationally for wind estimates from cloud motions, landmark registration, and data evaluation are presented. The experimental uses of the digital data, such as cloud-top height analysis, sea surface thermal analysis from time composites, solar insolation estimates, and tropical storm rain potential estimates for landfalling storms, are presented.

19292 (CONF-7804163—(Vol.3), pp 2121-2130) **Volcanic gas eruption velocity sensor using a spatial filter.** Tsutsumi, S.; Takemura, K.; Itakura, Y. (Kyoto Inst. of Tech., Japan). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Quantitative informations about temperature, concentration, and escaping velocity of the volcanic eruption from the craters will or may provide some parameters necessary to estimate the grade of volcanic activity or the heat energy stored in the volcanic area. Some experimental results are given for application to remote sensing of the escaping velocity of the volcanic gas, smoke or steam jet

by the use of a phase locked loop followed after the balanced modulator and a spatial filter such as a plus-minus strip-formed detectors' linear array with either a silicon photovoltaic detector or a pyroelectric detector.

19293 (CONF-7804163—(Vol.3), pp 2245-2254) **Ionospheric and satellite observations for studying the dynamic behavior of typhoons and the detection of severe storms and tsunamis.** Hung, R.J. (Univ. of Alabama, Huntsville); Smith, R.E. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Atmospheric acoustic-gravity waves associated with severe thunderstorms, tornadoes, typhoons (hurricanes) and tsunamis can be studied through the coupling between the ionosphere and the troposphere. Reverse ray tracing computations of acoustic-gravity waves observed by an ionospheric Doppler sounder array, show that wave sources observed by an ionospheric Doppler sounder array, show that wave sources are in the nearby storm systems and that the waves are excited prior to the storms. Results show that ionospheric observations, together with satellite observations, can contribute to the understanding of the dynamical behavior or typhoons, severe storms, and tsunamis.

19294 (PNL—3300(Pt.3)) **Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.** Long, G.B. (ed.). (Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1980. Contract EY-76-C-06-1830. 188p. Dep. NTIS, PC A09/MF A01.

Separate abstracts were prepared for 37 sections of the report. An author index and a list of presentations and publications are also included. (JGB)

19295 (PNL—3300(Pt.3), pp 3-4) **Net radiation measurements at Geysers Geothermal Site: Project ASCOT, July 1979.** Nickola, P.W.; Orgill, M.M.; Laulainen, N.S.; Doran, J.C.; Glover, D.W. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

Net radiometers were deployed at two valley sites for surface cooling measurements. The period of net positive radiation was found to be about 12 hr/day at each site, with positive values starting at about 0600 PST and ending shortly after 1800 PST. Analog traces of the net radiation data are presented, and preliminary observations are discussed. (JGB)

19296 (PNL—3300(Pt.3), pp 7-8) **Tethersonde data at the Geysers Geothermal Site: Project ASCOT, July, 1979.** Orgill, M.M. (Pacific Northwest Lab., Richland, WA); Schreck, R.I.; Horst, T.W.; Neff, W.D.; Larson, R.S. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

Two mobile tethersonde units were utilized in the Anderson Creek area near Middletown, California during the July, 1979, field effort for Project ASCOT (Atmospheric Studies in Complex Terrain). Data were obtained from two sites for six nighttime and early morning periods. Vertical profiles of wind, temperature and humidity were taken about every hour except when strong winds, equipment malfunction or weather prevented them. A ground station received the data remotely, which was printed on a paper tape. The tethersonde data volume is in the process of being data-edited and plotted. Data are being placed on punch cards and after editing will be placed on a data tape. At the present time the edited, monaveraged data are being processed by a computer plotting routine for preliminary assessment and analysis. The tethersonde data from both Anderson Creek sites and other data collected during this period will eventually be analyzed to define the vertical and horizontal mesoscale wind and temperature variations for this July period. Data for July 23, 1979 are given.

19297 (PNL—3300(Pt.3), pp 19-21) **Aircraft measurements of turbidity in urban and rural atmospheres.** Laulainen, N.S.; Alkezweeny, A.J. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

The optical properties of aerosols are being studied in order to relate them to the physical and chemical properties. Two different air masses were investigated; one was dominated by aerosol from the Chicago/Gary urban and industrial area, the other had moved in from rural areas in Canada. Size distributions were measured and turbidities calculated. Aerosol extinction (scattering) coefficients were determined at different altitudes and are tabulated. (JGB)

19298 (PNL—3300(Pt.3), pp 27-28) **Drift from mechanical draft cooling towers.** Laulainen, N.S. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

A comprehensive experiment to study drift from mechanical draft cooling towers was conducted. The objective of the experiment was to establish a data base for use in drift deposition model validation. This objective was achieved by the simultaneous measurement of cooling tower source emission parameters, meteorological variables and drift deposition patterns during seven of eight test runs. The results from six of these test runs are presented and discussed.

19299 (PNL—3300(Pt.3), pp 79-84) **Method of initialization of wind fields over a region for the primitive forecast equations.** Huang, C.H.; Drake, R.L. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

A wind field model, applied to a specific flow field over the portion of northeastern United States and southeastern Canada, is described. This boundary outlines the MAP3S (Multistate Atmospheric Power Production Pollution Study of the Department of Energy/Environmental Protection Agency) computational domain that extends approximately 2400 km along the abscissa and 1360 km along the ordinate. A direct method was used for obtaining mass-consistent wind fields that can be used to initialize primitive forecast equations. This method is simpler and more effective than indirect methods based on the balance equation and the omega-equation, or certain variational methods. Using the direct method for initialization and reinitialization of dynamic equations also reduces induced instabilities as compared with the current indirect methods. The direct method is especially suited for use in mesoscale and regional modeling over data-sparse regions. (JGB)

19300 (PNL—3300(Pt.3), pp 84-86) **Back trajectories using an eight-layer diabatic model.** Davis, W.E. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

An eight-layer diabatic model that operates on the calculation of forward trajectories based on isentropic considerations was modified to calculate back trajectories. Basically the model consists of eight layers using gridded wind, temperature, and mixing ratio of fields to calculate the horizontal and vertical movement. The model also includes an estimate of the diurnal variations of temperature within a layer. In the new approach, layer winds used to transport the parcels are calculated separately from the grid points that have potential temperature closest to that of the parcel. This technique means that in a steeply sloped isentropic surface that all four winds could potentially be in different layers. If no such layer exists at one or more of the corner winds, the remaining winds are used. Problems encountered in tracking back trajectories, including wind shear with height, are discussed. (JGB)

19301 (PNL—3300(Pt.3), pp 124-125) **Correlations of extreme air temperatures at 30 cm and 120 cm on the ALE Reserve, Hanford.** Thorp, J.M. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

Monthly maximum and minimum temperatures at 30 cm above ground have been measured at 26 sites on the Arid Lands Ecology (ALE) Reserve of the Hanford Project since 1971. Rain, snow, deep dust or washout have occasionally prevented scientists from reaching one or more of the remote sites on the scheduled monthly basis. To make estimates of such missing data or to provide temperature estimates at 30 cm for times other than those when the monthly extremes occur, the 30-cm and 120-cm, monthly extreme temperature from the Rattlesnake Springs station (about 10 km southwest of the Hanford Meteorology Station) for the period September 1971 to May 1979 have been examined for correlation. The correlation coefficient, r, is 0.9963, which indicates a close correlation (perfect correlation when $r = +- 1.0$) between the temperatures at 30 cm and those at 120 cm. Results indicated that, on the average, extreme monthly temperatures at 30 cm are slightly more than 2°F colder than at 120 cm for the Rattlesnake Springs site.

19302 (PNL—3300(Pt.3), pp 145-147) **Differential turbidity at Hanford.** Laulainen, N.S.; Kleckner, E.W.; Michalsky, J.J.; Stokes, G.M. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

Experiments continued in FY 1979 to examine differential turbidity effects on insolation as measured at the earth's surface. These experiments are primarily intended to provide means for interpreting insolation-data assessment studies. These data are also valuable for inferring aerosol radiative or optical effects, which is an important consideration in evaluating inadvertent climate modification and visibility degradation as a result of aerosols. The experiments are characterized by frequent, nearly simultaneous observations at the Rattlesnake Mountain Observatory (RMO) and the Hanford Meteorological Station (HMS) and take advantage of the nearly 1-km altitude difference between these two observing sites. This study indicated that nearly simultaneous measurements of the direct solar beam from stationary sites that are separated in altitude can be used to monitor the incremental optical depth arising from aerosols in the intervening layer. Once appropriate calibration procedures have been established for the MASP unit, the direct solar data

can be used to document on a routine basis aerosol variations in the first kilometer between HMS and RMO.

19303 Comments on "The characteristics of turbulent velocity components in the surface layer under convective conditions," by H. A. Panofsky, H. Tennekes, D. H. Lenschow, and J. C. Wyngaard. Hicks, B.B. (Argonne National Lab., IL). *Boundary-Layer Meteorol.;* **15**: 255-258(1978).

Panofsky et al. (1977) have presented an analysis which seems to show a clear dependence of the dimensionless turbulence statistics on the planetary boundary-layer stability parameter. However it is possible that much of the apparent relationship results from artificial correlations introduced by the use of inter-related dimensionless parameters. Apparent dependencies of similar statistical quantities on stability parameter in the surface boundary layer might also be contaminated.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 18352, 18353, 18837, 19169, 19272, 19285, 19294, 19360, 19709, 19710

19304 (BNL—51116) **Environmental control technology for atmospheric carbon dioxide. Final report.** Albanese, A.S.; Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). Sep 1979. Contract EY-76-C-02-0016. 58p. Dep. NTIS, PC A04/MF A01.

The impact of fossil fuel use in the United States on worldwide CO_2 emissions and the impact of increased coal utilization on CO_2 emission rates are assessed. The aspects of CO_2 control are discussed as well as the available CO_2 control points (CO_2 removal sites). The primary factor affecting the practicability of a CO_2 control system is the energy required by the control system. Of the three potential CO_2 control points, removal from the stacks of fossil fuel power plants appears to require the least amount of energy. Estimates of the energy required to capture and recover CO_2 from coal-fired power plant stacks by various processes are presented. Although capture and recovery of CO_2 is an important consideration in the overall scheme of CO_2 control, disposal or reuse of recovered CO_2 may be the weakest link in the CO_2 control chain. Of the several options considered, deep ocean storage appears to be the most promising. Two control scenarios are evaluated, one based on the absorption of CO_2 contained in power plant flue gas by seawater; the other, based on absorption of CO^2 by monoethanolamine (MEA). Captured CO_2 is injected into the deep ocean in both cases. Analyses indicate that capture and disposal by seawater is not feasible, whereas capture and disposal using MEA is a possibility. However, the economic penalties of CO_2 control are significant; for example, at a CO_2 removal efficiency of 50%, it is estimated that the power generation efficiency of a conventional coal fired power plant would be reduced from 34 to about 25%. The cost of power generation would be expected to double. For 90% CO_2 removal, power generation efficiency is reduced to between 15 and 6% and the cost of power generation increases by a factor of from 4 to 7.

19305 (CONF-7804163—(Vol.1), pp 219-234) **Monitoring environmental pollution by remote sensing.** Vass, P.A.; van Genderen, J.L. (Environment and Resource Consultancy, Berkshire, England). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Various types of environmental pollution which may be studied by remote sensing are outlined. Also man's detrimental effect on the land as a result of his development activities is discussed; this is of particular relevance to developing countries. The role of different remote sensors such as airborne cameras (including panchromatic, colour, colour infrared and multiband systems), airborne thermal and multispectral line scanners, side looking radar and satellite imagery for the identification and monitoring of the environmental pollutants and their effect are evaluated.

19306 (CONF-7804163—(Vol.1), pp 257-269) **Remote sensing for air pollutin control.** Barringer, A.R.; Davies, J.H. (Barringer Research Limited, Rexdale (Toronto), Ontario). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Limitations in ambient monitoring have been well recognized particularly by atmospheric scientists engaged in regional air pollution transportation studies, international pollution studies and global changes. While some success has been achieved in large scale measurements through the use of ambient sensors mounted in ground mobile vehicles or aircrafts, it is only the advent of electro-optical techniques during the past ten years that has afforded major opportunities for true remote sensing or air pollution phenomena in sort timeframes of measurement and over large distances. The passage of radiation through the atmosphere is modified by the absorptions imposed by the atmospheric constituents present. These gases and vapours impose upon the radiation characteristic spectral absorptions which occur in the ultraviolet, visible, and infrared spectral regions. By the collection of this radiation and its subsequent spectral analysis, qualitative and quantitative measurements may be made on the various trace atmospheric species present. If characteristic spectral absorptions occur in regions where there is natural background radiation, such as daylight sunshine, or irradiation from the earth as a low temperature blackbody, passive absorption measurements may be made. If absorptions occur at inconvenient wavelengths for passive sensing, active sensing can be employed usng sources such as tunable lasers. A review of the concepts of remote sensing for atmospheric trace gas and vapour measurements, spectrometric, and interferometric techniques, and active and passive sensing is presented, along with consideration as to the applications of remote sensing to air pollution monitoring and subsequent pollution control. Prospects of satellite monitoring of air pollution are reviewed with a review of progress to date in satellite monitoring by direct nadir viewing and solar occulation measurements.

19307 (CONF-7804163—(Vol.2), pp 1279-1285) **Airborne lidar aerosol measurements over the US and Europe.** Werner, C.; Herrmann, H.; Kent, G.S.; Koepp, F. (DFVLR - Inst. for Atmospheric Physics, Oberpfaffenhofen, Germany). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

An airborne lidar system was developed for the observation of aerosol distribution and transport in the troposphere. Measurements were carried out over the United States (ASSESS II) and Germany. By means of some examples the benefit of this method is demonstrated.

19308 (COO—4776-2) **Heterogeneous chemistry of importance in decisions concerning the environmental impact of energy production and the siting of new energy sources. Progress report, March 1, 1979-February 29, 1980.** Castleman, A.W. Jr. (Colorado Univ., Boulder (USA)). Feb 1980. Contract EP-78-S-02-4776. 17p. Dep. NTIS, PC A02/MF A01.

Research progress in the following areas is reported: (1) the formation, stability, and structure of ion-clusters both by high pressure mass spectrometric experiments and approximate molecular orbital quantum mechanical calculations; (2) the exchange of energy and angular momentum during ion-molecule association reactions using computer dynamics calculations; (3) related experimental and theoretical studies of nucleation and solvation phenomena; (4) laser photophysics of ion clusters including measurement of cross sections for photodissociation, fluorescence, and energy exchange by pulsed infrared techniques; (5) the growth, stability, and structure of weakly-bound van der Waals and charge-transfer complexes employing electric deflection techniques and taking advantage of the first-order Stark effect; and (6) the multiphoton ionization of metal atom clusters to probe the transition from the isolated atomic to the condensed metallic state, and to elucidate their electronic states and potential as sites for the catalytic conversion of absorbed pollutants.

19309 (DOE/EV—0071) **Carbon Dioxide Effects Research and Assessment Program. Carbon Dioxide Research Progress Report, fiscal year 1979.** Dahlman, R.C.; Gross, T.; Machta, L.; Elliott, W.; MacCracken, M. (Department of Energy, Washington, DC (USA). Office of Health and Environmental Research; National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Environmental Research Labs.; California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1980. 88p. Dep. NTIS, PC A05/MF A01.

Research on the global carbon cycle and the effects of increased carbon dioxide on the global climate system is reported. Environmental and societal effects related to CO_2 and environmental control technology for CO_2 are also discussed. Lists of research projects and reports and publications of the Carbon Dioxide and Climate Research Program are included. An expanded CO_2 monitoring network is providing increased coverage for interpretation of patterns of sources and sinks seasonal variability, and documentation of the global growth of CO_2. Modeling studies emphasized that knowledge of the transport and mixing of surface ocean waters is important in understanding deep oceanic circulation. Initial studies in the equatorial Pacific are helping quantify estimates of the amount of outgassing CO_2 from tropical waters. During fiscal year 1979, there was a substantial increase in appreciation of the role of the ocean in controlling not only atmospheric CO_2 concentrations but also the climatic response to changes in concentration. Model simulations of the effect of doubled CO_2 concentration carried out with fixed ocean temperatures a situation that is possible during perhaps the next 20 years, showed relatively small summer heating over land areas. On the other hand, simulations in which the oceanic temperatures could come into instantaneous equilibrium with atmospheric conditions continued to show global temperature increases of 3 +- 1.5°C, accentuated at high latitudes. To improve understanding of possible regional climate changes, there were increased efforts to reconstruct regional climatic patterns prevailing during past warm periods that might serve as analogs of future climatic conditions. Particular attention was directed to the climates of the United States and other

countries bordering the North Atlantic Ocean during the warm period 5000 to 7000 years ago.

19310 (IVL-B—517) **Oxidized nitrogen compounds in long-range transported polluted air masses.** Grennfelt, P. (Swedish Water and Air Pollution Research Lab., Goeteborg). Oct 1979. 10p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The emissions of nitrogen oxides have increased at a relatively high rate during the 1960s and '70s, while emissions of many other substances, e.g., soot and sulfur dioxide, have remained at a more or less constant level. One may also expect a further increase in the emissions of nitrogen oxides in the next decade. Last year, data from a number of OECD countries indicated an increase in NO/sub x/ emissions of about 40 to 60% between 1972 and 1985. This rapid increase will probably not only lead to effects on the local scale but directly or indirectly cause effects over large regions. In order to investigate the long range transport and conversion of nitrogen oxides, measurements of oxidized nitrogen compounds have been undertaken at a remote station (Roervik) at the Swedish west coast. The measurements comprise NO and NO_2, monitored continuously with a chemi-luminescent instrument; particle-borne nitrate on Fluoropore filters; and gaseous nitrates (HNO_3) with a method based on adsorption on impregnated filters. The NO_2 values obtained with the chemiluminescent monitor will include other gaseous nitrogen compounds as well, such as PAN and HNO_3. Unless otherwise specified, the NO_2 value in the presentation includes these substances. Nitrogen oxides were monitored between 1976 and 1978 and gaseous nitrates mainly between June 1977 and June 1978. Particulate nitrates have been monitored occasionally only during this period; most of the data on particulate nitrates are from measurements prior to 1976.

19311 (ORNL/MIT—291) **Survey of methods for isolating and containing gaseous carbon dioxide as nonvolatile products.** Hohmann, R.P.; Kwai, A.H. (Massachusetts Inst. of Tech., Oak Ridge, TN (USA). School of Chemical Engineering Practice). Apr 1980. Contract W-7405-ENG-26. 28p. Dep. NTIS, PC A03/MF A01.

Methods for removing carbon dioxide from stack gases and from the atmosphere and for its storage in nonvolatile form are discussed, and the economic and technical feasibility of each method is considered. None of the methods seems promising at present. A number of feasibility, economic, and other studies are suggested.

19312 (PB—80-102015) **Refinery heater screening study. Report for 1978.** Ayraud, S.L.; Schreiber, R.J. (Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.). Mar 1979. Contract EPA-68-02-2611. 63p. NTIS, PC A04/MF A01.

This screening study provides a general background description of refinery heaters, an inventory of their application, and estimates of SOx, NOx, and HCx emissions.

19313 (PB—80-102809) **Indicatory fate study. Final report, May 1978-February 1979.** Myers, L.H.; Short, T.E. Jr.; DePrater, B.L.; Pfeffer, F.M.; Kampbell, D.H. (Environmental Protection Agency, Ada, OK (USA). Robert S. Kerr Environmental Research Lab.). Aug 1979. 105p. NTIS, PC A06/MF A01.

This report is concerned with media disposition of specific priority pollutants. Composite samples were obtained from the influent, effluent, residuals, and air from 12 industrial biological treatment systems. These samples were extracted and analyzed by gas chromatography for organic constituents, by atomic absorption for metals, and by EPA methodology for phenolics, cyanide, and mercury. Participating industries included: (1) organics and plastics, (2) pharmaceuticals, (3) pesticides, (4) rubber, (5) wood preservative, and (6) petroleum refining. The data in this report represent potential disposition of specific priority pollutants during 3-day study periods and should not be construed to represent a mass balance study.

19314 (PB—80-112162) **Systematic sensitivity analysis of air quality simulation models. Final report, January-December 1978.** Gelinas, R.J.; Vajk, J.P. (Science Applications, Inc., Pleasanton, CA (USA)). May 1979. Contract EPA-68-02-2942. 107p. NTIS, PC A06/MF A01.

This report reviews and assesses systematic sensitivity and uncertainty analysis methods for applications to air quality simulation models. The discussion of the candidate methods presents their basic variables, mathematical foundations, user motivations and preferences, computer implementation properties, and costs (including both human and computer resources). Both deterministic and sampling methods have been evaluated. Deterministic methods include the time- and user-honored method of arbitrary parameter adjustments by trial and error, variational methods, and a newly formulated Green's function method (for kinetics systems only). Sampling methods include Monte Carlo sampling of the outputs of air quality models to compute variances and a Fourier analysis method of sampling model outputs to compute expectation values of sensitivity coefficients.

19315 (PB—80-801202) **Beryllium pollution (a bibliography with abstracts). Report for 1964-October 1979.** Brown, R.J. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 178p. NTIS PC N01/MF N01.

The bibliography covers research on air and water pollution by beryllium. This includes sources; control; detection and analysis; toxic effects on plants, animals, humans; and air and water quality emissions. Environmental levels of radioactive and radiation--produced beryllium are excluded. (This updated bibliography contains 172 abstracts, 16 of which are new entries to the previous edition.)

19316 (PB—80-801921) **Sulfate emissions from automobiles (citations from the Engineering Index data base). Report for 1964-November 1979.** Cavagnaro, D. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 8p. NTIS PC N01/MF N01.

The cited reports from a worldwide literature survey relates to sulfate exhaust emissions from automobiles. The topics cover the chemistry, the relationship of sulfur oxides and sulfates, control equipment design and effectiveness, and the environmental impacts. (This updated bibliography contains 83 abstracts, 16 of which are new entries to the previous edition.)

19317 (PB—296625) **Dispersion of pollutants near highways. Data analysis and model evaluation. Final report, September 1975—July 1978.** Rao, S.T.; Keenan, M.; Sistala, G.; Samson, P. (New York State Dept. of Environmental Conservation, Albany (USA)). Feb 1979. 173p. NTIS, PC A08/MF A01.

The validity of various assumptions underlying mathematical modeling of pollutant dispersion near at-grade highways was examined and the simulation capability of various dispersion models determined. The data base generated during the Long Island Dispersion Experiment is used to study the micro-meteorological characteristics adjacent to a highway and to evaluate four numerical and four Gaussian highway dispersion models.

19318 (PNL—3300(Pt.3), pp 4-7) **Fluorescent particulate tracer experiments at Geysers Geothermal Site: Project ASCOT, July 1979.** Nickola, P.W. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

Fluorescent particulate tracers were released in the Anderson Creek Valley near Middletown, CA during 4 nights when drainage flow was anticipated. The results of the sequential sampling at the Anderson Creek-Socrates Mine Road crossing are presented. Sequential sampling increments were 15 min during Test 1 and 10 min during the other three tests. A comparison of the duration of tracer release with the duration of tracer passage at this 2.7-km downvalley point reveals well-above background concentrations for a period of at least twice the dispersal duration. Only during Test 2 did the observed short-period concentration reach expected continuous plume value. On the basis of the experiments, it can be concluded that if crosswind tracer sampling is included in subsequent ASCOT field experiments, sampling should be extended much farther up the side of the valley. (JGB)

19319 (PNL—3300(Pt.3), pp 9-13) **Sulfur surface flux measurements.** Droppo, J.G. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

Results of profile surface-layer sulfur flux studies are reported. These studies entailed the acquisition of approximately 1 hr of nucleopore filter samples taken at three log-spaced heights. The volume and temperature of air drawn through each filter was monitored to allow accurate flow corrections. The material on the filters was analyzed using a specially developed x-ray fluorescence procedure to maximize the accuracy of the gradient values. Three levels of detailed micrometeorological data were also recorded to define eddy diffusivities. The results from three sites are presented here: Centralia (grassland), Hanford (arid vegetation), and Sangamon (cornfield).

19320 (PNL—3300(Pt.3), pp 14-17) **Sensitivity of particle deposition to changes in deposition velocity.** Doran, J.C. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

The effects of varying deposition velocities on the removal rates of gaseous pollutants were studied. A relatively simple model was utilized to examine the sensitivity of particle deposition to changes in the deposition velocity when the particle is small. The model incorporates the diurnal variations of winds, eddy diffusivities, and surface resistance terms, and illustrates the complexity of the interactions of these factors in determining concentration patterns for pollutants.

19321 (PNL—3300(Pt.3), pp 17-18) **Application of the modified source depletion model.** Horst, T.W. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

Horst (1979) proposed a modification of the source-depletion diffusion-deposition model, and its predictions compared quite well to the surface-depletion model when using a Lagrangian similarity diffusion model. However, the Lagrangian similarity model is theoretically limited to near-surface releases and short downwind distances. Since the Gaussian diffusion model with empirical formulas for σ/sub z/ has a broader potential application, the aerodynamic resistance of the Gaussian diffusion model has been derived for use in the modified source depletion model. The resulting predictions are shown here to compare very well with the surface depletion model. A procedure is also suggested for use with particles that have a finite settling velocity.

19322 (PNL—3300(Pt.3), pp 22-25) **Pollutant transformations in the atmosphere.** Kalkwarf, D.R.; Garcia, S.R. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

The purpose of this study is to identify transformations of polycyclic aromatic hydrocarbons (PAHs) that occur at significant rates in the atmosphere. This information is needed to more accurately assess the environmental impact of coal-fired power plants. Laboratory experiments focused on measuring the sublimation half-times of PAHs so that their distribution between vapor and fly ash states in the atmosphere could be evaluated. These atmospheric distributions are significant since several PAHs are known to be more reactive in the adsorbed state. Also, concentrations of PAHs in particulate samples must generally be corrected for sublimation losses during high-volume sampling. In addition, a new helicopter-mounted, vapor/particulate sampler was developed and used to sample air along the stack-emission plume at Colstrip, Montana. Fluoranthene and pyrene were found to be largely in the vapor phase, whereas benzo[a]pyrene and perylene were completely adsorbed on particulates. After correction of data for dilution as a result of plume dispersion, the degradation half-distances for fluoranthene and pyrene were both found to be 7 km. Sublimation half-times of fluoranthene, pyrene and chrysene from coal fly ash were measured and compared with calculated values for the pure compounds. Experiments were conducted in both static air and air flowing with a linear velocity of 0.7 ms^{-1}, typical of high-volume samplers. Samples taken March 16, 1979, provided the most complete data to show the degradation of PAHs with distance from the stacks. At each sampling point, vapor and particulate concentrations of a PAH were added, divided by the concentration of calcium and plotted versus distance as shown in Figure 18. Although measured concentrations of all PAHs at 1.6 km from the stacks appear unreasonably low, concentrations measured further out indicate that fluoranthene and pyrene have degradation half-distance of 7 km.

19323 (PNL—3300(Pt.3), pp 29-30) **Development of a national interregional transport matrix for emitted fine particulates.** Eadie, W.J.; Davis, W.E.; Sandusky, W.F. (Pacific Northwest Lab., Richland, WA). Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

A tool was developed for assessing air quality impacts resulting from emitted fine particulates. To develop this tool, fine particulate transport and removal calculations were made by use of a long-range transport model (Eadie and Davis 1979). A unit emission source was placed at the centroid of each National Air Quality Control Region (AQCR), and the air quality impact on each AQCR was computed. The final product of the calculations is a matrix of the average, fine particulate concentration for each receptor AQCR resulting from the unit fine particulate emission from each AQCR. The AQCR-to-AQCR matrix is then utilized with any siting scenario of energy technology use to predict the air quality impact on any AQCR of the projected emissions from other AQCRs by multiplying the appropriate matrix elements by the projected emissions and summing the products over the emitting AQCRs. The matrix approach will allow the ranking of air quality impacts of various energy technology scenarios without rerunning the long-range transport model. In order to investigate seasonal variations, 4 monthly, average matrices were produced using meteorological data from January, April, July, and October 1974. The data are tabulated.

19324 (PNL—3300(Pt.3), pp 35-38) **New regional-scale assessment method based on assessments at regularly spaced grid points.** Davis, W.E.; Eadie, W.J. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

In some cases, the number of the sources that have to be taken into account for long-term environmental assessment using a variable trajectory model make the computer requirements of such an assessment prohibitive. In order to attempt to reduce the number of assessments, and thereby their cost, research has been carried out to investigate a new approach for making a large number of assessments based on a relatively few number of assessments at regularly spaced intervals (Eadie and Davis 1980). In order to test whether such an approach is valid, a series of case studies were carried out using the long-range transport model. The model simulates plume elements released hourly from an emission source. Five sources were used in one case study, where four of these formed a box at illustrated grid locations, and the fifth was a source in the Four Corners area. This test was run for a simulation of emitted particulates in the respirable size ranges of approximately 0.1 to 3 μm in dia with a dry deposition velocity of 0.23 cm sec^{-1} and a wet removal rate of 0.38 $P.^{73}$ hr^{-1}, where P is in mm hr^{-1} (Eadie and Davis 1979). Hourly precipitation was used for wet removal in the test case. Results are tabulated. The main differences that can be noted are that the air concentration pattern region in eastern Wyoming is not as low as in the source assessment. Other than a region in southeastern Montana where there is an underestimate by the weighted values, fairly good agreement was maintained between the two assessments for centerline values.

19325 (PNL—3300(Pt.3), pp 43-46) **Predictions of incloud conversion rates of sulfur dioxide to sulfate based upon a simple chemical and dynamical model.** Scott, B.C. (Pacific Northwest Lab., Richland, WA). Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

A simple chemical model was developed to estimate the percentage of total wet-deposited sulfate and nitrate that is derived from an incloud, aqueous-phase conversion process. The model does not explicitly define a conversion mechanism but assumes that the bulk of the sulfate originates either from nucleation of aerosol composed of $(NH_4)_2SO_4$, NH_2HSO_4, $CaSO_4$, $MGSO_4$, K_2SO_4 or from the conversion of SO_2 to $SO_4^{=}$. Nitrate is assumed to originate from NH_4NO_3 or from some unspecified aqueous-phase conversion of NO/sub x/ to NO_3^{-}. Applying the above model to data from the Multistate Power Production Pollution Study (MAP3S) Precipitation Chemistry Network for the eastern United States results in predictions that 55 to 90% of the wet-deposited sulfate is the result of incloud conversion during winter, and 75 to 90% of the sulfate is a conversion product in the summer. Incloud conversion is predicted to account for 75 to 100% of the wet-deposited nitrate during the winter and 40 to 100% of the wet nitrate flux during the summer. The output from this chemical model was used as input for a newly developed, simple storm model that applies over scales of 1000 km and is based upon pollutant and vapor fluxes into and out of a storm. The cloud model uses semi-empirical relationships to predict cloud updraft velocities, cloud heights and time available for conversion to occur within the condensed liquid water of the storm. Using this predicted conversion time and the value of mass produced by conversion from the chemical model, values of incloud conversion rates for conversion of SO_2 to SO_4/sup =/ can be obtained. Application with the regional precipitation data from the MAP3S network yields incloud winter conversion rates of SO_2 to SO_4/sup =/ of near 1% h^{-1}, whereas during the summer months, conversion rates are predicted to be near 10% h^{-1}. (JGB)

19326 (PNL—3300(Pt.3), pp 46-48) **Wet sulfate deposition in winter storms.** Scott, B.C. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

Beginning with the winter of 1976 to 1977, intensive experiments have been conducted yearly in which simultaneous observations of precipitation chemistry and subcloud aerosol and gas concentrations were obtained. The experiments were performed in Muskegon, Michigan. One objective of these experiments was to relate sulfur deposition to ambient gas, aerosol, and meteorological conditions. The results obtained for sulfur wet removal during 15 snowstorms occurring in a 3-yr period are summarized.

19327 (PNL—3300(Pt.3), pp 51-52) **Generalized one-dimensional model of reactive pollutant behavior, including dry deposition, precipitation formation, and wet removal.** Hales, J.M. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

A computer code was developed that provides finite-difference approximations to solutions of a series of one-dimensional, time-variant equations corresponding to the conservation of atmospheric species. In its present form the computer code provides for: variable diffusion in height and in time; generalized boundary conditions at both the bottom and top of the computational grid, allowing a versatile characterization of the deposition/resuspension process; flexible vertical grid spacing; the capability to describe cloud and precipitation phenomena; the versatile incorporation of aqueous-phase and gaseous-phase chemical conversion for multiple-component systems; and, the capability to describe wet removal processes. At present, the code was tested only to a limited extent. The first test series addressed a comparison of the reactive scavenging of sulfur dioxide gas with the physical scavenging of sulfate aerosol. For the purposes of this test, nucleation was stipulated to be the sole mechanism of direct sulfate aerosol capture, and the aqueous-phase reaction of SO_2 with ozone was specified as the sole SO_2 conversion mechanism. Results of the initial test, which depicts a storm system induced by orographic lifting with subsubsequent descent across a plateau, are summarized. (JGB)

19328 (PNL—3300(Pt.3), pp 53-56) **Comparison between polluted and clean air masses over Lake Michigan.** Alkezweeny, A.J.; Laulainen, N.S. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

The Lake Michigan area offers a unique site to study and characterize aerosol and trace gases in clean and polluted air masses. Field experiments were conducted in the Michigan area to characterize and investigate the formation of secondary pollutants. Presented here are data collected during the summers of 1976 and 1978 in a sampling program that consisted of airborne measurements of aerosol particle size distributions and chemical composition, light scattering and ozone. Meteorological conditions under which the data were collected are described. The concentrations of a few trace metals measured on 2 days in 1976 are given. It is clear that the differences in measurements are more than an order of magnitude between clean and polluted air. The ranges of sulfate, nitrate, ozone, and light-scattering measurements during five experiments over Lake Michigan are tabulated. The data presented here demonstrate that background levels do exist even in the highly industrialized northwest of the United States. (JGB)

19329 (PNL—3300(Pt.3), pp 61-63) **Relationship among secondary pollutants.** Alkezweeny, A.J. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

During the summer of 1978 several aircraft sampling missions were carried out over Lake Michigan to monitor and study the formation of secondary pollutants such as ozone and sulfate. Ozone measurements were made with a Bendix ozone analyzer, and a MRI integrating nephelometer was used to determine the aerosol light-scattering at a wavelength of 0.525 μm. Aerosol particles were also collected on IPC filters at the rate of 1.4 m^3/min and analyzed by x-ray fluorescence for sulfur content. The relationship between ozone and sulfate is plotted. The data are fitted with a straight line using linear regression analysis on 47 pairs of data points. The correlation coefficient between the two parameters if 0.9. Such high correlation suggests that sulfate particles in the atmosphere are formed by photochemical reaction. The data presented here were collected under low relative humidity conditions (below 75%). Therefore, it is possible that catalysis of sulfur dioxide at high relative humidity may be important. A plot of the light scattering (B/sub scat/) versus sulfate particle concentration is also given. The B/sub scat/ values are time-averaged over the same period of filter sampling times, and they represent the component of scattering as the result of aerosol alone. The correlation coefficient, calculated from 55 pairs of data points, is 0.94. This high correlation demonstrates the strong contribution of sulfate to visibility degradation in the atmosphere. (JGB)

19330 (PNL—3300(Pt.3), pp 63-64) **Measurement of atmospheric hydrogen peroxide.** Lee, R.N. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

A chemiluminescent technique that has been applied to both integrated and real-time detection of H_2O_2 during moderate smog episodes. This technique utilizes the metal-catalyzed reaction of H_2O_2 with luminol for the quantitative determination of H_2O_2 in aqueous solution. A similar system was used for the analysis of integrated samples of H_2O_2 acquired during urban plume flights over Lake Michigan and the Central Illinois Rain Chemistry Experiment (CIRCE) experiment in central Illinois during the summer of 1979. The analyzer unit is described and results are tabulated. Results suggest the need for continued investigation of the analytical technique to establish its suitability for use in polluted atmospheres. (JGB)

19331 (PNL—3300(Pt.3), pp 69-72) **Initial comparisons of SURE/MAP3S sulfur oxides observation with long-term regional model predictions.** McNaughton, D.J. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

First efforts to verify a long-term regional model applicable for monthly or annual predictions of the transport and removal of airborne sulfur oxides are summarized. Monthly model predictions of ambient concentrations of sulfur dioxide and sulfate and total sulfur removed by precipitation scavenging are presented in tables and figures, and are compared to observed data collected from the measurement networks in the northeast United States for August and October 1977. Results of two study cases are presented where Case 1 is a base case for making predictions and Case 2 is a modification of the base case without near-source Gaussian dispersion and urban SO_2 to SO_4/sup =/ transformation rates which are subgid-scale parameterizations. Model evaluation statistics for airborne sulfur oxide concentrations are presented. Base case predictions of SO_4/sup =/ deposition by precipitation are given. Predictive capabilities of the regional model and the sensitivities of the model to subgrid-scale parameterizations are shown in figures which are plots of air concentrations of sulfur oxides to location on two cross sections. Monthly model results show promising predictive capabilities for a long-term regional model based on initial comparisons with a new data base.

19332 (PNL—3300(Pt.3), pp 73-76) **Emission source specification in a regional pollutant transport model.** McNaughton, D.J. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

Modeling of regional air pollutant transport, transformation, and removal presents the problem of analysis of inputs, processes and desired results over a range of spatial and temporal scales. Model sensitivity tests are presented to investigate bounding model complexity and computational expense while assuring prediction of main parameter effects and interactions. The anaysis compares model results for source specification alternatives to base case results and an observed data set including sulfur dioxide and sulfur sulfate air concentrations and the concentration of sulfur oxides in precipitation. Senstivity studies of emission source specifications indicate that approximations can be useful in minimizing the required resolution of emissions data in the model.

19333 (PNL—3300(Pt.3), pp 87-89) **Modeling evidence of incloud transformation of sulfur dioxide to sulfate.** McNaughton, D.J.; Scott, B.C. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

Predictions over the northeast United States were made with a regional transport model. Concentration calculations were made hourly for grid elements approximately 35-km square using mass conservation equations for sulfur dioxide and sulfur sulfate coupled through a linear transformation term. Other terms in the equations allowed for calculation of wet and dry removal. Monthly average air concentrations and deposition for SO_2 and SO_4/sup =/ were simulated for August and October 1977. The desired effect of increasing precipitation sulfur is shown by increases of approximately a factor of 2 in SO_4/sup =/ removed by precipitation. Observed and predicted values of sulfur deposition are compared with base case underprediction and the changes produced by considering incloud transformation of SO_2. The impact of incloud transformation modifications through the use of model evaluation statistics is summarized. Results show the most significant changes between cases are the increase in the maximum SO_4/sup =/ concentration in August and the change in the correlation between observed and predicted SO_4/sup =/ values in October. Each effect is caused by an overprediction of SO_4/sup =/ in the area of maximum SO_2 emissions. Differences between August and October results indicate the need for different responses to convective storms or large-scale synoptic storms. Simulating enhanced incloud transformation of SO_2 to SO_4/sup =/ appears to be a means for reducing the discrepancy between model predictions and observations; that is, significant increases in sulfur oxide concentrations in precipitation can be produced without drastically changing ground-level air concentrations of SO/sub x/. Initial tests suggest that an incloud conversion rate of 10% h^{-1} may be close to the proper magnitude, but in general, slightly overpredicts water and air concentrations of SO/sub x/.

19334 (PNL—3300(Pt.3), pp 95-96) **Literature ranges of paricle dry deposition velocities.** Sehmel, G.A. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

Independent measurements of particle dry deposition velocities have been reported in the literature for many field experiments. However, there have been limited cross-comparisons between results. Consequently, a comparison between field results is made here for experimental results in which the particle diameter range is indicated. In general, the data show the following: the deposition velocities in any individual experiment range over several orders of magnitude; and that a minimum deposition velocity exists and is approximately 10^{-2} cm/sec for particle diameters in the range of 0.1 to 1 μm dia. Generalizing from these early field experiments has been limited in that experimental variables have not been adequately controlled, i.e., often the particle size distribution has either not been known or reported. Since deposition velocities are a function of particle diameter, most field determined mass transfer data should be interpreted with qualification when generalization is attempted. For predictive generalizations, a particular model is recommended.

19335 (PNL—3300(Pt.3), pp 97-98) **Literature ranges of dry deposition velocities for gases.** Sehmel, G.A. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

The reported ranges of deposition velocities for 16 different gases are given. The range of deposition velocities is at least one order of magnitude for each gas. For nitrogen oxides (NO and NO/sub x/), the range is actually from minus to positive numbers. For all gases other than krypton, the range of deposition velocities is from 10^{-4} to 7.5 cm/sec. For Kr the maximum deposition rate is seven orders of magnitude lower, 2.3×10^{-11} cm/sec. More detailed deposition velocity data for I_2 and SO_2 are tabulated. Generalization

of these summarized results is confounded by the wide deposition velocity ranges that have been measured. Possibly ordering the data with respect to more recent versus older data might decrease the data ranges. Nevertheless, at present we must conclude that dry deposition velocities for gases cannot be accurately predicted. Even for I_2 and SO_2, which have been investigated must extensively, the deposition velocity range is two to three orders of magnitude. Obviously, considerably research is needed to predict accurately or to generalize dry deposition removal rates for gases. (JGB)

19336 (PNL—3300(Pt.3), pp 99-102) **Equipment for dual tracer dry deposition measurements.** Schmel, G.A.; Hodgson, W.H. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences

An experimental technique is being developed to measure the dry deposition of particles and gases over complex terrain. The maximum response of the airborne lithium particle detector for a particle diameter of about 1 μm is very encouraging and essential for proposed dual tracer deposition velocity field measurements. The concept behind these experiments is that we will measure only the minimum particle dry deposition velocity over various complex terrains. This predicted minimum deposition velocity occurs for particle diameters in the range of about 0.1 to 1 μm, which approximates the response range of the lithium particle detectors. Satisfactory operating ranges for lithium traced particle generation have now been determined. Preparations are being made to generate particles under field conditions and to measure particles downwind from the generation site. After sufficient testing has been done to determine airborne concentrations of ambient background lithium particles as well as required tracer particle generation rates, dry deposition experimentation will begin using depositing lithium-traced particles and nondepositing SF_6 gas.

19337 (PNL—3300(Pt.3), pp 102-104) **Literature ranges of wind and mechanically caused resuspension factors.** Schmel, G.A. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

One method of estimating the potential airborne concentration of particles to which a person is subjected while in a contaminated area is to use a resuspension factor. The resuspension factor is defined as the airborne pollutant concentration per unit air volume at or near breathing height divided by the pollutant surface contamination per unit area in which the person is living or working. The resuspension factor has units of m^{-1}. Resuspension factors have been reported in the literature for various experiments. The purpose here is to show in graphical form all these resuspension factor data. Resuspension factors are shown for both mechanically and wind-caused resuspension. Resuspension factors for mechanically caused resuspension are shown in the upper portion of the figure, and resuspension factors for wind stresses are shown in the lower portion. In both cases the data have been ranked in terms of descending order of the maximum resuspension factor reported for each experiment. In addition, the resuspension factor range for each experiment is shown by a horizontal line with vertical end marks. If only a single resuspension factor is reported, this datum is shown as an open circle. Several conclusions can be drawn from this figure. First, the figure does not correlate, rather only shows a graphical representation from maximum to minimum reported resuspension factors. The range of resuspension factors within some individual experiments can be over several orders of magnitude. Mechanically caused resuspension factors range over nine orders of magnitude from 10^{-10} to over 10^{-2} m^{-1}. Wind-caused resuspension factors range over seven orders of magnitude from 10^{-10} to 10^{-3} m^{-1}. The maximum resuspension factors were caused by mechanical stresses. (JGB)

19338 (PNL—3300(Pt.3), pp 104-107) **Wind-caused particle resuspension rates at two sites.** Schmel, G.A. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

Wind-caused resuspension rates are shown for two study sites using inert calcium molybdate tracer particles as pollutant simulants. For one site, resuspension rates tended to remain constant with time. At the second site, resuspension rates were decreasing with increasing time. Since these experiments are continuing, long-term changes in these resuspension rates will be determined. Long-term resuspension effects are needed for environmental assessments of surface-contaminated areas. Previously, some credit could have been given for decreased resuspension with time. This potential credit is now questionable in light of the resuspension reported results, and thus, assessment studies must also consider the data presented here. Although nominal submicrometer and 6-μm tracer particles were sprayed as resuspension sources, each source would have a tracer particle size distribution. This distribution is reflected in calculated resuspension rates for each stage of the cascade impactor. Each resuspension rate was calculated based on the total source concentration rather than the source concentration as a function of the tracer particle size distribution after deposition and weathering. Still to be determined is an initial experimental relationship between the tracer size dsitribution on the ground versus the tracer size distribution as resuspended on host particles.

19339 (PNL—3300(Pt.3), pp 126-128) **Comparative study of the Hanford dispersion model.** Droppo, J.G. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

The Hanford atmospheric dispersion model is documented and compared with recently compiled dispersion data bases. The Hanford Model for computing atmospheric dispersion has been historically used for dispersion estimates at Hanford. Since this model was based on dispersion tests at Hanford, the model has been promulgated as the best relationship for predicting dispersion at Hanford. The agreement between the predicted and measured lateral dispersion values shows that the predicted Hanford Model lateral dispersion values are reasonable. The conclusion that the Hanford Model is conservative when extended beyond its original short range is indicated.

19340 (PNL—3300(Pt.3), pp 133-135) **Assessment of research needs in the oil shale industry.** Parker, G.B. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

Studies on the environmental effects of processes for the extraction of oil from shale were reviewed. It is concluded that there were limitations in modeling efforts to predict air quality and environmental impact, and that results do not give an accurate indication of the environmental impact of an oil shale industry on Colorado, Utah, and Wyoming. It is recommended that a systematic study be conducted to characterize the particulates, gases, and vapors resulting from oil shale processing. The physical transport and deposition of particulates, gases, and vapors need to be assessed. Also needed are estimates of the air quality expected in the different regions likely to be developed, evaluations of the need for pollution control under different levels of development or different combinations of technologies, and determinations of suitable monitoring programs. (JGB)

19341 (PNL—3300(Pt.3), pp 135-139) **Basis and design of atmospheric transport studies proposed for the oil shale region.** Schmel, G.A. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

Recommendations are made for the design of validated fugitive source and airborne plume depletion model directed toward predicting possible consequences of the developing oil shale industry. Air monitoring stations for use in model development must be located at oil shale sites that adequately represent airborne pollutant concentrations in an area rather than at sites selected only because of current electrical power availability. It is anticipated that the investigations at selected sites will depend on the level of current or proposed oil shale activity. Possible, a radio-controlled station will be located at each site at which baseline data were obtained. Such a comparison might allow more profitable use of the baseline data. Since great uncertainty is inherent in current predictive techniques for airborne pollutant transport and plume depletion, predictive models need adaptation to or development on a site-specific basis. Tracer field experiments using many air-sampling stations will be required to adequately describe and validate/adjust models to predict fugitive emissions, transport, and downwind plume depletion within the oil shale region. In addition, on a regional basis, models to predict the enhanced total or joint concentrations caused by plume mixing from several sources need to be developed and validated.

19342 (PNL—3300(Pt.3), pp 143-145) **Hanford turbidity during 1979.** Laulainen, N.S. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

Turbidity measurements at Hanford during FY 1979 are summarized. The 1979 turbidities exhibit the same kinds of seasonal variations as do those for the previous years, except possibly for a phase difference of 1 to 2 wk in the maxima. Most of the maxima are associated with periods of air mass stagnation. Sources of smoke and dust are most pronounced in the spring, mid-July to mid-August and September to October and appear to be related primarily to agricultural activity, such as tilling and planting, crop harvesting, and field-burning in the Basin region. Occasionally, windstorms will cause considerable increases in turbidity through suspension of dust. Turbidity measurements during these periods are not always made because of cloudiness that is often associated with such events.

19343 (TULEA—1979-14-T) **Chemical analysis of PAH in diesel exhaust gases.** Rehnberg, O.; Nilsson, E.; Christiansson, J. (Tekniska Hoegskolan, Luleaa (Sweden)). May 1979. 63p. (In Swedish). Dep. NTIS (US Sales Only), PC A04/MF A01.

Four different diesel fuels were used in these tests. Besides polycyclic aromatic hydrocarbons (PAH), the content of CO, CO_2, HC and NO/sub x/ in the exhaust gases was also measured. It was found that the lighter fuels gave a lower PAH content in the exhaust

and that a catalytic converter, working at proper temperature, efficiently eliminated PAH.

19344 (UCID—18583) **Potential changes to stratospheric ozone from possible chlorofluorocarbon production.** Wuebbles, D.J.; Tarp, R.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Mar 1980. Contract W-7405-ENG-48. 35p. Dep. NTIS, PC A03/MF A01.

The Environmental Protection Agency has derived a series of scenarios for future atmospheric emission rates of the chlorofluorocarbons $CFCl_3$. These scenarios are based on potential industrial production and commercial applications, and the eventual release of these chemicals into the atmosphere. In this study, the potential effect on stratospheric ozone resulting from future chlorofluorocarbon emissions as suggested by these scenarios are examined. Assessments are based upon model calculations using the one-dimensional coupled transport and chemical kinetics model of the troposphere and stratosphere developed at Lawrence Livermore Laboratory (LLL).

19345 (UCRL—83887) **Aerosol dispersion and coagulation from a coal-fired power plant: a three dimensional numerical model.** Buckholtz, H.T.; Biermann, A.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1980. Contract W-7405-ENG-48. 20p. Dep. NTIS, PC A02/MF A01.

A computational model to simulate the dispersion and coagulation of aerosols emitted from coal-fired power plants was constructed. In modeling the dispersion of the aerosol, turbulent diffusion and wind-driven advection are treated by a finite-difference method. Molecular coagulation is incorporated in the model to follow shifts in the particle-size distribution. Particulate coagulation is mathematically described by Timiskii's equation. The relevent semi-empirical work of Smirnov is incorporated in the model to provide for the coagulation constant. Input for the model is a bimodal, particle-size distribution measured at an operating coal-fired power plant. Simulations indicate that dispersion competes against coagulation mechanisms to maintain the bimodal shaped distribution for 32 km. Turbulence and particle settling tend to enchance coagulation effects. The size-dependent spatial segregation of particles within the plume is predicted.

19346 (UCRL—84135) **Future sensitivity of NO_2 to hydrocarbon and NO/sub x/ controls: Results of photochemical diffusion modeling in the San Francisco Bay area.** DeMandel, R.E.; Perardi, T.E.; Robinson, L.H.; Duewer, W.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1980. Contract W-7405-ENG-48. 9p. (CONF-800327—10). Dep. NTIS, PC A02/MF A01.

From 2. joint conference on applications of air pollution meteorology; New Orleans, LA, USA (24 Mar 1980).

The application of a grid-based photochemical model to the problem of nitrogen dioxide (NO_2) simulation is reported. The performance of the Livermore Regional Air Quality model (LIRAQ) was evaluated with meteorological conditions of 5 November 1976, a day on which high NO_2 concentrations were observed. Statistical measures of model performance show that NO_2 and O_3 are predicted about as well as O_3 was on a previous prototype day chosen for high observed O_3. A sensitivity study was completed with 1985 source inventories to test the effect of HC and NO/sub x/ emission reductions on ambient NO_2 and O_3 levels. Reductions in HC only or NO/sub x/ only are about equally effective in reducing ambient NO_2. Simultaneous reduction of both precursors is slightly more effective. Reduction of HC only is clearly the most effective strategy for O_3 control. Simultaneous reduction of HC and NO/sub x/ is less effective, and reduction of NO/sub x/ alone significantly increases O_3 levels.

19347 **Air sampling and analytical procedures for benzidine, 3,3'-dichlorobenzidine and their salts.** Morales, R.; Rappaport, S.M.; Hermes, R.E. (Los Alamos Scientific Lab., NM). Contract W-7405-ENG-36. *Am. Ind. Hyg. Assoc. J.;* **40**: No. 11, 970-978(Nov 1979).

The purpose of the study was the development of new air-sampling and analytical procedures for benzidine, 3,3'-dichlorobenzidine and their salts. Air is drawn through a glass-fiber filter followed by a bed of silica gel to collect these substances as either particles or vapors. The compounds are extracted from the sampler and analyzed by HPLC with sensitivities in the range of 3 $\mu g/m^3$ for 48-L air samples. the methods were evaluated in the laboratory with test aerosol atmospheres and found to be unaffected by temperature or humidity of the sampled environment. Tests of precision, sample stability and separation from interferants indicate that the method should provide reliable results for personal monitoring procedures.

19348 **New method for in-place testing of tandem HEPA filter installations.** Schuster, B.G.; Osetek, D.J. (Los Alamos Scientific Lab., NM). Contract W-7405-ENG-36. *Am. Ind. Hyg. Assoc. J.;* **40**: No. 11, 979-985(Nov 1979).

A new in-place high-efficiency particulate air (HEPA) filter testing procedure has been developed, based on the use of an intracavity laser particle spectrometer for ultrasensitive detection of challenge particulate concentrations downstream of tandem HEPA filter installations. The feasibility of these measurements had initially been demonstrated on a small-scale laboratory system where overall protection factors of 10^9 were routinely measured. The primary scaling problem for systems up to 200,000 CFM was in producing sufficient challenge aerosol. This was accomplished by the design and construction of a high-volume thermal dioctyl phthalate generator. The results of acceptance testing of 13 tandem HEPA filter systems, performed with both the spectrometer technique and conventional light-scattering photometry, are displayed and problem areas discussed.

19349 **Generation and characterization of condensation aerosols of vanadium pentoxide and pyrene.** Tu, K.W.; Kanapilly, G.M. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM). Contract EY-76-C-04-1013. *Am. Ind. Hyg. Assoc. J.;* **40**: No. 9, 763-769(Sep 1979).

Generation and characterization of submicron aerosols of V_2O_5 and pyrene, two materials with very different physicochemical properties, were studied. Vaporization-condensation methods were used to generate the aerosols. The effects of various experimental conditions on particle size and aerosol mass concentration were investigated. Also, chemical stability of the aerosols and the source materials with respect to temperature was determined. experimental results show that there are significant differences in the nature of pyrene and V_2O_5 aerosols. These methods and experimental conditions can be easily adapted for generation of heterogeneous condensation aerosols of pyrene and V_2O_5.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 18479, 18897, 19294

19350 (PNL—3300(Pt.3), pp 76-79) **Study of HTO plume washdown in an eight-layer computer model.** Davis, W.E. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

The model used for the case study here was a modified version of an eight-layer diabatic transport model developed by Davis and Wendell (1976). The modification in their model was in the calculation of net removal. A short case study was made for April 1 to 15, 1974, based on a plume leaving St. Louis, Missouri. Hourly releases were made and a time step of one hour was used inthe advection step. Hourly precipitation was used to calculate washdown. Results of comparing air concentrations of HTO with and without plume washdown were somewhat surprising in that very little if any differences in air concentrations could be detected close in to the source. At greater distances, differences as great as an order of magnitude occurred in the calculation of surface air concentrations of HTO. The conclusion of this study is that significant differences are predicted by the model for air concentrations. Further work should be done on the model to determine why there were no significant differences near the source.

19351 (PNL—3300(Pt.3), pp 118-124) **Atmospheric radionuclide concentrations at Richland, Washington and Barrow, Alaska.** Young, J.A.; Thomas, C.W. Feb 1980.

In Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences.

Concentrations of a wide spectrum of radionuclides have been measured biomonthly at Richland, Washington since 1961 and monthly at Barrow, Alaska since 1964. Since the end of atmospheric nuclear testing by the United States and Russia in 1962, radionuclides have been released into the atmosphere primarily as a result of atmospheric tests by France and by the People's Republic of China. The Chinese have conducted about 25 atmospheric nuclear tests at a rate of one or two a year since 1964. Primarily becuase of Chinese nuclear tests, the decrease in atmospheric concentrations of nuclear weapons radionuclides has been slow since about 1966. The yearly average concentrations of zirconium-95, cesium-137, plutonium-238, plutonium-239, and americium-241 at Richland in disintegrations per minute per 10^3 standard cubic meters since 1962 are shown. Average monthly concentrations of Be-7 and Na-22 at Richland and Barrow from 1967 through 1978 are tabulated. Relative concentrations of I-131 in different chemical and physical forms as measured at Richland following the Chinese nuclear tests are given. Average monthly concentrations of Pb-210 at Richland and Barrow from 1975 through 1978 are also tabulated. (JGB)

THERMAL EFFLUENTS MONITORING AND TRANSPORT

19352 (PNL—3205) **Physical modeling of flow over an axisymmetric knoll under neutral atmospheric conditions.** Cliff, W.C.; Smith, J.D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1980. Contract EY-76-C-06-1830. 46p. Dep. NTIS, PC A03/MF A01.

A glass-walled hydraulic (water) flume was used to model physically air flow near an axisymmetric knoll in a neutral atmospheric boundary layer. The knoll was a 1:250 scale model. An upstream velocity profile (1/7 power law), characteristic of a neutral atmospheric boundary layer, was produced by locating a 10-cm-high (4-in.) trip near the flume entrance and by appropriately roughening the flume floor. Mean velocity, rms velocity, and turbulence intensity profiles were measured at locations near the knoll using an existing laser Doppler anemometer system. The flow accelerated over the knoll and produced a relatively uniform velocity profile at the crest. The measured velocity profile was in close agreement with a theoretical velocity profile developed using potential flow theory and an upstream power law velocity profile. The turbulence intensity decreased at the crest of the knoll as a result of the flow acceleration.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 19281

ENVIRONMENTAL SCIENCES, TERRESTRIAL

BASIC STUDIES

REFER ALSO TO CITATION(S) 18416, 18785, 18929, 19288, 19289, 19290, 19502, 19505, 19506, 19523, 19540, 19541

19353 (CONF-7804163—(Vol.1)) **Proceedings of the twelfth international symposium on remote sensing of environment.** (Environmental Research Inst. of Michigan, Ann Arbor (USA). Center for Remote Sensing Information and Analysis; Natural Resources Management Center, Ouezon City (Philippines)). 1978. 836p. Dep. NTIS, PC A99/MF A01.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

This is the first of three volumes of the proceedings of the Twelfth International Symposium on Remote Sensing of Environment, held 20 to 26 April 1978 in Manila, Philippines. This symposium is part of a continuing program investigating current activities in the field of remote sensing. The meeting is intended to promote increased international cooperation in research, development, and application of this technology, and to stimulate an exchange of information on all aspects of this multidisciplinary field through the presentation of reports on work planned, in progress or completed. Presentations include those concerned with the utilization of this technology in various national and international programs as well as in numerous applications for monitoring and managing the earth's resources and man's global environment. Ground-based, airborne, and spaceborne sensor systems and both manual and machine-assisted data analysis and interpretation are included. All papers included in their entirety were abstracted and indexed for EDB/ERA.

19354 (CONF-7804163—(Vol.1), pp 17-25) **Remote sensing program of the Philippines (country report).** Roque, C.R. (Dept. of Natural Resources, Quezon City, Philippines). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Development of the use of aerial surveys in the Philippines is summarized. Applications of satellite remote sensing to land use, agriculture, forestry, geology/meteorology/hydrology, and surveys of coastal and aquatic resources are outlined. The role of LANDSAT data is emphasized. Future plans are discussed. (JGB)

19355 (CONF-7804163—(Vol.1), pp 37-41) **Thailand national remote sensing program: past, present & future.** Sabhasri, S. Cheosakul, P.; Indrambarya, B.; Vibulsresth, S. (National Research Council, Bangkok, Thailand). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Thailand's participation in NASA LANDSAT-1, SKYLAB, and LANDSAT-2 programs has resulted in the availability of an up-to-date and accurate information required by various government agencies concerned with the planning for development and the management of natural resources at the national level. The success of studies in several disciplinary areas has led to a more vigorous research and development programs with an aim at quasi-operational status, especially in forestry, land use, agriculture and environmental monitoring. A national remote sensing coordination center was established, and a regional remote sensing training center is taking shape. Discussion on a ground receiving station for LANDSAT is also included.

19356 (CONF-7804163—(Vol.1), pp 43-54) **Country report: India.** Rao, K.R. (National Remote Sensing Agency, Andhra Pradesh, India). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Remote sensing has now graduated into an operational phase in India especially with the establishment of National Remote Sensing Agency. The list of users is increasing day by day. Already more than a third of India has been interpreted using remote sensing techniques (both LANDSAT and airborne data) in NRSA itself, for a variety of themes. With the acquisition of experience in the space segment, another dimension will be added to the application of remote sensing techniques for multidisciplinary surveys.

19357 (CONF-7804163—(Vol.1), pp 55-62) **Application of remote sensing for development in Australia.** Ryan, J.F. (Dept. of Science, Canberra, Australia). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Background information on remote sensing activities in Australia is provided, together with a reference to plans for the establishment of an Australian LANDSAT Station. A number of the remote sensing programs both of a research and operational nature that have been undertaken or are in progress at the present time are then identified.

19358 (CONF-7804163—(Vol.1), pp 63-68) **Bangladesh Landsat Programme—a review of the programme and a report on the activities.** Hossain, A.; Chaudhury, M.U.; Pramanik, M.A.H. (Bangladesh LANDSAT Task Force, Dacca). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Bangladesh LANDSAT Programme is a multisectoral resource survey programme using spacecraft imagery from the LANDSAT earth observation satellites of NASA. The sectors involved are agriculture, forestry, water resources, cartography, fisheries, oceanography, instrumentation, meteorology, geology, and statistics. The digital mapping of the coastal land accretion, winter crop estimations and forest inventory using LANDSAT data are underway. A comprehensive study of the watershed areas in Chittagong Hill Tracts is being made using LANDSAT imageries to find the rate of siltation in Karnafuli Hydel reservior. Surface water and ecological study in the west and south western part of Bangladesh are also being carried out. Preparation of a digital color landuse map of Bangladesh using LANDSAT data is also planned. Plans for Phase II of the project are discussed.

19359 (CONF-7804163—(Vol.1), pp 69-80) **Satellite remote sensing activities in Iran.** Jazayeri, B.; Naderi, F. (Iranian Remote Sensing Center, Tehran). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The events that led to the Iranian Government's decision to establish a ground receiving station for the purpose of acquiring data from earth resources and meteorological satellites are summarized. In addition to a brief description of the systems procured, special attention is paid to some of the problems that have been encountered by Iran in this endeavor, particularly those that appear to apply to developing nations in general.

19360 (CONF-7804163—(Vol.1), pp 81-91) **Remote sensing activities in Japan.** Mamiya, K. (Science & Technology Agency, Tokyo, Japan). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Remote sensing activities in Japan are reviewed. Construction of the LANDSAT ground receiving station will be completed by the end of 1978. The following programs have made use of aerial remote sensing techniques: oceanography and fishery; environment preservation; agriculture and forestry; land use; disaster prevention; geology and mineral resources; meteorology; and, fundamental research. (JGB)

19361 (CONF-7804163—(Vol.1), pp 95-111) **Applications of remote sensing to the study of the agricultural and natural resources.** Sharifi, M.A. (Ministry of Agriculture and Rural Development, Tehran, Iran). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Some of the current remote sensing activities of the Informatics and Remote Sensing Department of the Ministry of Agriculture and Rural Development, Imperial Government of Iran are surveyed. Development of suitable techniques for using remotely sensed data in a variety of applications is currently in progress. Many of the projects are still at the experimental stage, but the range of the projects is broad. Current activities include the preparation of land use maps, the development of a crop yield forecasting system, and the development of techniques for predicting the quantity of water available from the melting of snow and techniques for monitoring changes in forest areas, and so on. The progress on these projects is described.

19362 (CONF-7804163—(Vol.1), pp 113-121) **Remote sensing activities in the German Democratic Republic.** Kautzleben, H. (Academpyy of Sciences of the GDR, Potsdam, Germany); Bormann, P.; Joachim, R. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A cooperative USSR-GDR integrated remote sensing experiment called Raduga was carried out in September 1976. During this experiment orbital multispectral photography was taken from board of the manned Soviet spacecraft SOJUS 22, aerial photography flown over selected test areas and extensive ground information collected. Basic parameters of this high-resolution photographic remote sensing system using indigenously developed technology are given, and some of the interpretation techniques applied and results achieved so far are outlined.

19363 (CONF-7804163—(Vol.1), pp 123-124) **Pakistan national programme of remote sensing applications.** Ahmad, M.S. (Pakistan Space & Upper Atmosphere Research Committee, Karachi). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The use of remote sensing techniques in Pakistan is reviewed briefly. The available LANDSAT data covering the entire territory of Pakistan averaging 24 scenes (orbits) constitute a source of information of great value in practically all kinds of investigations of natural environment and resources. The applications made or in progress utilizing the LANDSAT imagery include: floodplain mapping of the rivers in the Indus River Basin; snow-line mapping in the catchment areas of the Indus River Basin; morphology of the Indus deltan and adjoining coastal belt of Pakistan; geological and mineralogical prospects in Pakistan; mapping of coastal areas to determine the concentration of heavy minerals; terrain survey of the northern areas of Pakistan; analysis of demographic patterns in the Northwest Frontier Province; water-logging, salinity control and land reclamation projects in the province of Sind; survey of Indus River course for planning and construction of flood protective bunds; hydrographic study of Sonmiani coastal area including tidal culture of the lagoon and extent of suspended materials in the lagoon waters; forest, rangeland, and vegetation mapping of Pakistan; survey of grazing resources of desert rangelands in the province of Sind; and resource management in various areas of Pakistan. (JGB)

19364 (CONF-7804163—(Vol.1), pp 125-129) **Argentina remote sensing program.** Pena, M.S. (National Commission on Space Research, Buenos Aires, Argentina). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Argentine geography is described. Main resources are identified and its economical importance is discussed. The objectives of the remote sensing program are pointed out. Human resources and equipment available or in the process of acquisition are mentioned.

19365 (CONF-7804163—(Vol.1), pp 133-138) **Remote sensing activities in Malaysia.** Nor, S.M. (Forest Research Inst. Kepong, Selangor, Malaysia). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A review of activities in aerial photointerpretation in Malaysia is given. The main impetus to remote sensing was generated by the Land Capability Classification Program of 1962. Panchromatic aerial photographs at 1:25,000 were used for all projects and found useful, though not optimal for some purposes. Experience with LANDSAT imagery is limited and less developed than in other Association for Southeast Asian Nations (ASEAN) countries. This is due to a relatively well developed communication system, maps, and aerial photographs, and an absence of a specific agency to promote use of LANDSAT imagery. The Geological Survey of Malaysia carried out some preliminary survey using Landsat imagery and found it useful for specific purposes. A preliminary land use mapping using an enlarged color composite positive also gave encouraging results. As a result, a National Remote Sensing Committee has been set up to coordinate and develop remote sensing in this country. A proposal for an ASEAN Remote Sensing Training Center has been put forward to the relevant authorities by this committee. It is hoped that remote sensing will continue to develop in Malaysia, especially in view of proven applications in other developing countries, but pursuit of LANDSAT programs must be with caution and need to be fully assessed as to their benefits.

19366 (CONF-7804163—(Vol.1), pp 139-144) **Resources assessment and remote sensing in Costa Rica.** Guardia, R.E.Q. (Ministerio de Agricultura y Ganaderia, San Jose, Costa Riga); Rudin, F.N.; Rodriquez, H.; Campbell, R.W. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Increasing pressures of agricultural development have resulted in rapid and uncontrolled destruction of one of Costa Rica's most important natural resources, its forests. Accelerating urban growth has simultaneously caused a loss of high value agricultural acreage and a resulting impact on the country's principal source of foreign exchange. The Government of Costa Rica has recognized these problems and, as a first step, has established several natural resource/remote sensing programs in order to provide an assessment and inventory of the country's natural resource base and urban land-use patterns.

19367 (CONF-7804163—(Vol.1), pp 145-158) **Italian activities in the domain of remote sensing.** Cassinis, R. (Univ. of Milano, Italy). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

During the past three years some experimental programs reached an operational or quasi operational stage. From aerial and satellite platforms multispectral analysis is used to study the coastal waters in areas influenced by large river discharge. The airborne thermal scanners are currently used to locate and estimate the outlet of coastal freshwater springs. The stress of particular types of crops has been evaluated and some vegetative covers classified. The fast degradation of soil in the Appennini mountain range has been evaluated by the temporal analysis of satellite imagery. The remote sensing data are used also as contribution to structural geology mainly in the domain of earthquake hazard reduction. The experimental programs presently include the preparation to HCMM investigation; the continuous monitoring of the integrated radiance from one active volcano; the olive trees census and classification. These developments have been enhanced also by the facilities of the Italian ground receiving station of LANDSATS.

19368 (CONF-7804163—(Vol.1), pp 159-173) **Earth resources satellite remote sensing in New Zealand.** Ellis, P.J. (Physics and Engineering Lab., Lower Hutt, New Zealand). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The use of Earth resources satellite data in New Zealand began with the LANDSAT II Investigation Programme. An account is given of the progress of these investigations over two years from October 1975. This was a co-operative exercise between eight user organizations and a newly formed remote sensing section which acted as the co-ordinating agency, and was responsible for technology development. The results of the projects are discussed, covering most of the earth science disciplines, and some thought is given to the possible action required to ensure continued participation in the future, including the establishment of a ground receiving station.

19369 (CONF-7804163—(Vol.1), pp 179-185) **United Nations role in satellite remote sensing.** Murthy, H.G.S. (United Nations, New York, NY). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Spectacular progress has been made in the last twenty years since mankind's conquest of outer space began. Within the next two decades there will be few areas untouched by new space developments or by the application of lessons and technologies already developed in the course of space exploration. New materials, electronics, computers, machine tools, medical instruments and power sources were conceived and built to make possible man's great leap into space. Now, only a few years after their initial development, much of the technology created for space has been found to have exciting applications in the struggle to solve earth-bound problems. Dr. Kurt Waldheim, the present Secretary-General of the United Nations, speaking as President of the United Nations Conference on the Exploration and Peaceful Uses of Outer Space in 1968, said: When these benefits are stated in concrete terms, however, their importance to all countries, and in particular to the developing countries, becomes readily apparent. Outer space research and its practical applications are, by their very nature, of global concern and will require to an ever-increasing degree the co-operation of all nations. Smaller countries which do not at this time have the resources for an independent space programe have made, and are still making, important contributions in space science and research. There is no doubt that these countries, if given adequate opportunities, could also greatly contribute, through their participation in joint space projects, to the technological conquest of outer space.

19370 (CONF-7804163—(Vol.1), pp 187-201) **Remote sensing technology and new development trends in Latin America.** Adrien, P.M. (Inter-American Development Bank, Washington, DC); Bartolucci, L.A. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Visual and digital analysis of remotely sensed data provided by earth resources satellites are being used in many development projects in Latin America. The basic remote sensing activities which have taken place in recent years and continue to increase in the continent are outlined. The progress achieved by the countries of the region is surveyed, and new development trends occurring in various sectors of these nations are pointed out.

19371 (CONF-7804163—(Vol.1), pp 203-211) **Remote sensing technology transfer: the Canadian-Peruvian approach.** DuBois, F.P. (ONERN-Peru, Ottawa, Ontario); Bruce, B.D. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

In 1974 the Government of Peru approached the Canadian Government for assistance in expanding Peruvian remote sensing capabilities. This lead to the formalization of Project PERCEP in 1976. The basic goal of this project is to contribute broadly to the integrated development of viable remote sensing capabilities within the Peruvian resources evaluation program. The project design is outlined, and the development of its basic concepts is discussed. Emphasis is placed on the values of an integrated and cooperative approach to technology transfer in remote sensing. A brief statement is also presented of the current status of this cooperative Canadian-Peruvian Project after one year of activities.

19372 (CONF-7804163—(Vol.1), pp 277-282) **Ground truth collection techniques.** Wagner, T.W.; Lowe, D.S. (Environmental Research Inst., Ann Arbor, MI). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Ground truth is essential to the success of most remote sensing projects. It serves to provide the basis for relating the remotely-sensed data to the specific parameters of interest in any practical application and to help evaluate the project results. Types of ground truth include historical records, maps, and imagery; field observations; and ancillary data such as model results or laboratory measurements. Field observations require considerations of platforms and instrumentation. A key aspect is the selection of an appropriate sampling strategy in terms of the quality and quantity of data. Ground truth can be obtained from preexisting sites, from carefully chosen sites, from randomly selected sites, or from transects or from a combination of these.

19373 (CONF-7804163—(Vol.1), pp 283-287) **Remote sensing data collection: a review of aircraft and satellite systems.** Smith, J.T. (Daedalus Enterprises, Inc., Ann Arbor, Michigan). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

For the past two decades, the sciences and disciplines involved in the field identified as Remote Sensing, have made great strides forward, and operational status in several areas is being approached. Airborne sensors and their vehicles are now sufficiently understood and can be specified and deployed with considerable confidence. In general, the technologies and disciplines needed for successful airborne remote sensing projects have been sharpened through twenty years of research, development, and operations and the subsequent decades will bring more refinements and utility to the techniques. The future of airborne remote sensing is bright for both aircraft and satellite systems. New satellite programs and their sensor complements are under development and reflect user needs and requirements. LANDSAT C & D, NIMBUS G, SEASAT, Space Shuttle, and the French SPOT Satellite will carry this concept through the 1990 time frame. Aircraft programs and sensor configurations are also receiving renewed attention and are being actively developed within the private industry sector.

19374 (CONF-7804163—(Vol.1), pp 297-321) **Microwave sensors and sensor systems.** Larson, R.W. (Environmental Research Inst. of Michigan, Ann Arbor); Schanda, E. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Radar and radiometer remote-sensing systems that utilize the microwave and millimeter segment of the electromagnetic spectrum provide nearly all-weather capability and can be operated day or night. In addition, systems operating in this wavelength region provide a measurement sensitivity to surface roughness scale which is orders of magnitude larger than optical or infrared systems. Examples of multispectral synthetic-aperture radar (SAR) imagery are discussed, and the state-of-the-art is evaluated. The data flow in an SAR system is illustrated. Also discussed are fundamentals of microwave radiometry, typical specifications of present-day passive sensors, and several applications of microwave radiometry. (JGB)

19375 (CONF-7804163—(Vol.1), pp 323-327) **Information extractin with human interpreters.** Olson, C.E. Jr. (Univ. of Michigan, Ann Arbor). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Information extraction with human interpreters is more cost-effective for some applications than machine processing of digital data. Information retrieval is maximizd, however, when human and machine capabilities are blended so that the advantages of one are used to overcome the limitations of the other. Use of computers to produce better images for human interpretation is one way that this can be done. In addition, careful choice of interpretation support equipment can substantially increase the effectiveness of human interpreters. Selection of such equipment should be based upon realistic appraisal of the work required, rather than on good looks and high cost.

19376 (CONF-7804163—(Vol.1), pp 329-353) **Digital image analyysis of Landsat data.** Alford, W.L. (Goddard Space Flight Center, Greenbelt, MD). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Digital image analysis of Landsat data provides the opportunity to produce products and results not available through conventional photointerpretation or analog processing. Some basic process functions that can be preformed digitally are defined, and a variety of computer peripherals including hard copy output devices and television terminals are discussed. The characteristics of stand-alone image analysis systems are compared, and the significant features of image processing and geographic information systems software are described.

19377 (CONF-7804163—(Vol.1), pp 355-369) **Review of current remote sensing satellite reception and preprocessing technologyy.** Park, A.B. (General Electric Co., Beltsville, MD); Strome, W.M. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Since the launch of LANDSAT 1 in 1972, a number of facilities have been built to receive and preprocess the data from this series of NASA satellites. More such systems are being planned. The newer receiving and preprocessing stations are more compact and efficient. The technology used is slowly evolving to meet the challenge of the higher data loads and more stringent user demands with regard to geometric and radiometric accuracy which are expected with the launch of LANDSAT-D in late 1981. The technology in use at the existing or planned stations is described, and the impact of LANDSAT-D on these facilities is discussed.

19378 (CONF-7804163—(Vol.1), pp 371-385) **Landsat-D, a systems overview.** Salomonson, V.V. (Goddard Space Flight Center, Greenbelt, MD). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

LANDSAT-D is scheduled for launch in 1981. LANDSAT-D will be an experimental earth resources monitoring system that is designed to be a complete, end to end, highly automated system providing a major step forward in global remote sensing. The spacecraft for the LANDSAT-D Project, caled the Multimission Modular Spacecraft (MSS), will have improved pointing accuracy and stability characteristics; namely, 0.01 degrees and 10^{-6} degrees per second, respectively. This spacecraft will be launched into a sun-synchronous orbit near 705 km so as to provide repetitive coverage at a frequency between 16 and 19 days. The principal instruments on the spacecraft will be the Thematic Mapper (TM) and the Multispectral Scanner Subsystem (MSS). The MSS will provide the same basic capability as the MSS on LANDSAT-3. The Thematic Mapper, however, is designed to provide capabilities significantly advanced over those of the MSS. The ground segment of this mission is also substantially advanced over previous ground data handling systems. The Data Management System (DMS) will be capable of receiving all necessary input for up to 100 TM scenes per day and 200 MSS scenes per day and producing as output 50 fully corrected TM scenes and 200 MSS partially corrected scenes on High Density Tapes (HDT's) along with film masters for the TM scenes and up to 10 TM scenes on Computer Compatible Tapes (ordered retrospectively through the EROS Data Center (EDC). All these data will be sent to EDC for archiving and distribution. The DMS will have the capability of producing these products in 48 hours. There will also be a LANDSAT-D Assessment System (LAS) which will be capable of performing analyses evaluating the quality and incremental improvement in observing capability afforded by the Thematic Mapper and assessing other factors related to achieving Project objectives.

19379 (CONF-7804163—(Vol.1), pp 387-394) **World wide approach to remote sensing and mineral exploration.** Carter, W.D.; Rowan, L.C. (Geological Survey, Reston, VA). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The Remote Sensing and Mineral Exploration Project of IGCP was initiated in 1976 to provide a forum for international communication among geologists interested in developing or learning about various aspects of LANDSAT remote sensing as geophysical exploration techniques. The project will attempt to correlate structural and spectral data derived from satellites and other sources with the distribution of known mineral deposits to serve as a guide to mineral exploration. The steps for obtaining such results include: visual lineament analysis of space images and mosaics for structural information; comparison with mineral deposit data; use of image enhancement and measurement techniques to detect alteration zones and discriminate specific rock types; and use of computers for analysis of images and data storage, retrieval and statistical analysis. Research under this project is divided into three broad categories: lineament analyses and their relation to the distribution of mineral and energy resources; spectral reflectance measurements using LANDSAT data and field spectrometers for discriminational rock types and alteration zones related to ore deposits plus image enhancement techniques; and studies of stressed vegetation and relationships with mineralized zones. The greatest emphasis at the present time has been on visual lineament analysis because of the widespread availability of synoptic LANDSAT images in black and white or color format. As the availability and knowledge of enhancement and computer analysis systems spreads we anticipate greater emphasis in the remaining research areas. A representative listing of the types and location of research projects that are underway or have been completed at this time is included. (JGB)

19380 (CONF-7804163—(Vol.1), pp 417-426) **Forest mapping and inventory techniques through visual analysis of Landsat imagery: examples from Thailand.** Morain, S.A. (Univ. of New Mexico, Albuquerque); Klankamsorn, B. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Since Thailand's first National Programme of ERTS training course in 1973, personnel of the Royal Forest Department have been utilizing LANDSAT imagery in their survey and mapping efforts. By 1977 they had: (1) completed a survey of existing forest land for the whole country at scales of 1:500,000 and 1:1,000,000; (2) designated forest lands to be conserved as catchment areas in the upper Chao Phya River Basin; (3) surveyed and assessed areas of shifting cultivation in northern Thailand; and (4) conducted a change detection study of forest conversion in the seven eastern provinces of the country. Associated studies by non-Royal Forest Department personnel have focused on detection and measurement of rubber plantations in eastern and southern Thailand, and on general land cover assessments in selected provinces comprising the Bangkok plain. A project planned for 1978 by the RFD will continue to use LANDSAT imagery in a general planning survey of northern catchment areas. The objectives of this project are to select prime areas for initiating crop replacement efforts among the hill tribes and to encourage these tribes to utilize waste land instead of converting existing forests through their traditional slash and burn techniques. All of these studies and applications have been performed by using black and white band 5 and 7 imagery at scales of 1:500,000. In most cases the determinations are supported by interpretation of 1:1,000,000 diazochrome false color composites and by the use of test sites and ground observations to verify results. Measurements of areas have been made by planimeter and dot grids and, in some cases, the values obtained compare within a few percentage points to those obtained by traditional means.

19381 (CONF-7804163—(Vol.1), pp 429-441) **Land use information system based on statistical inference.** Wigton, W.H.; Huddleston, H.F. (Dept. of Agriculture, Washington, DC). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

An efficient, practical, and accurate information system showing how to use some of the promising new technology is presented. An agricultural information system can be built on an objective ground based data and combined with LANDSAT data to increase the precision of statistics for large areas and also generate local data. The results or statistics produced will be defendable in a court of law if care is taken to follow strict procedures. Resource requirements vary depending on accuracy levels needed. However, the system combines ground based and LANDSAT data in a flexible manner depending on materials, equipment available, expertise and experience of personnel involved. The requirements for constructing an area sampling frame in a country will be discussed.

19382 (CONF-7804163—(Vol.1), pp 497-506) **Remote sensing use in hydraulic planification in Mexico.** Diez Perez, J.A. (Comision del Plan Nacional Hidraulico, Mexico City, Mexico). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Remote sensing has been applied in Mexico since 1968, when a project was conducted in collaboration with NASA. In this experiment information for a specific project was gathered with the help of a multiband aerial platform. A general description of the evolution and main results of the methods used in projects dealing with hydrology and agriculture is presented. Studies were conducted, using aerial and satellite information. One project, a principal investigation demonstrates the utility of LANDSAT, using three different test sites in Mexico, selected according to different climatic zones. Subsequently the same experimental setup was used to test the utility of SKYLAB. In another project, an inventory of land use was presented in a map made by visual techniques; this map is being used to define the extension of the agricultural areas in Mexico. Another set of maps are being produced now at a scale of 1:1,000,000 usng the SIADIS computer interpretation system.

19383 (CONF-7804163—(Vol.1), pp 507-511) **Decade of collection of in-situ environmental data utilizing earth orbiting satellites.** Moore, H.S. (Dept. of Commerce, Washington, DC); Puerner, J.H. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The launch of the Application Technology Satellites a decade ago offered a greatly expanded capability for collecting in-situ environmental data from remote areas. Satellite data collection was upgraded to an operational system in the summer of 1975 utilizing the United States Geostationary Operational Environmental Satellite (GOES). This system collects and distributes environmental data measured on remotely located attended and unattended data collection platforms located on land at sea or in the atmosphere. Data from a minimum of 10,000 of these platforms can be collected routinely by each of the two satellites in every six-hour synoptic period. Similar and compatible capability is also available from the European Space Agency (ESA) geosynchronous satellite and the Japanese Geostationary Meteorological Satellite (GMS). This global system will be instrumental in providing environmental data for the First Global Experiment of World Meteorological Organization's Global Atmospheric Research Program. The geostationary satellite data collection system is restricted to fixed platforms or to platforms where location can be determined by other means. To fill the need for platform location, the French space agency is supplying the ARGOS data collection and location system to United States for flight on their TIROS-N satellites. The ARGOS system is a simplification of the systems successfully flown on the French EOLE satellite. The only communication link between the users platform and the satellite is the platform to satellite one-way up link. The location information is determined by measuring the platform carrier frequency received by the satellite system. A differential Doppler technique of computation allows the platform position to be determined.

19384 (CONF-7804163—(Vol.1), pp 547-565) **Use of change detection in assessing development plans: a Philippine example.** Coiner, J.C. (Columbia Univ., New York, NY); Bruce, R.C. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A method that uses both remote sensing and information systems for collection, spatial analysis, and display of periodic data is presented. Findings presented here are from an aircraft/Landsat based change detection study conducted for the period 1948 to 1972 on Marinduque Province, Republic of the Philippines. The experimental information system for the Island allows collection and maintenance of spatial relationships inherent in the landscape through generalization of a preselected number of data elements into a uniform grid cell (twenty-five hectares). Each of the 4008 twenty-five hectare cells representing Marinduque were studied for changes in and betwen various development variables. These changes were measured and tested using nonparametric statistics to determine the effect of specific land cover changes on other infrastructure components and proximate land use. Techniques have been developed for more continuous updating of the Marinduque data base with Landsat data. The primary effort has been to extract for each twenty-five hectare cell an indicator of change as derived from UTM geometrically corrected and aggregated Landsat data. Anomalous or unique changes over time can thus be detected and corroborated either with ground reconnaissance or high resolution aircraft imagery. The experimental system used here demonstrates that it is possible to retain in one information system historical and current physical aspects of developing regions. In support of the planner's requirement for periodic observation, the study reveals both trends and seasonal and other periodic cycles in regional, settlement, and environmental patterns which, if unaccounted for by planners, would impact negatively on development projects. If properly used, these data provide better regional models than static base line approaches, thus markedly improving present development planning capabilities.

19385 (CONF-7804163—(Vol.1), pp 568-585) **Remote sensing, geographic information systems, and national land planning: some Central American and Caribbean experiences.** Shelton, R.L.; Tilmann, S.E. (Michigan State Univ., East Lansing). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Joint application of remote sensing and geographic information system technology is illustrated by projects in Puerto Rico, which focused on environmental protection and comprehensive land use planning, and in El Salvador, where information was provided for a national land reform effort.

19386 (CONF-7804163—(Vol.1), pp 587-595) **Procedures for land-use analysis in developing countries: examples from Southeast Asia.** Wacharakitti, S. (Kasetsart Univ., Bangkok, Thailand); Morain, S.A. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Since the launch of Landsat-1 in 1972, there has been a rapid increase in broadscale land-use analyses in the southeast Asian area. Data from three localities are presented. The first example describes a technique for classifying land cover types and measuring their areal extent in provinces comprising the Bangkok plain. Comparison of the measurement results with existing province data indicate where categories need refinement in definition and also provide an indication of measurement accuracy. A second example, from Laos, reviews a procedure for defining and measuring a single land-use category, broadly defined as cultivated land. Interpreters, following an agreed upon procedure, made independent dot grid estimates of cultivated land. Their results were evaluated by a third party and compared to official tabulations on a province-by-province basis. Redefinition, category refinement and alteration of the procedure was then agreed upon to reduce apparent measurement errors, and a second interpretation made. The third example focuses on northern Thailand and describes a procedure for using multi-date photogrphy and Landsat imagery to map land-use evolution. The technique and interpretation are more sophisticated than for the other examples, consequently category definition and measurement accuracy are more refined.

19387 (CONF-7804163—(Vol.1), pp 653-659) **Experiment on a popular multispectral image optical process.** Hsuan, H. (Inst. of Geography, Academic Sinica, Peking, China). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Experiments were conducted on multispectral false-color composite processing by using an imbibition transfer process and on preparation of mosics from LANDSAT images through the method of optical-mechanical rectification. Examples of interpretative geographical analysis on the aspects of land reclamation and utilization based on the experiment are cited.

19388 (CONF-7804163—(Vol.1), pp 703-718) **Earth orbital photography by the large format camera.** El-Baz, F. (Smithsonian Inst., Washington, DC); Ondrejka, R.J. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The Space Shuttle program will open the way for programs that apply what has been learned from previous space missions in order to obtain better photographs of the Earth. This will be done by using the so-designated Large Format Camera, which will permit the acquisition of mapping quality, stereo, and high-resolution (10 to 20 m) photographs on color and/or black-and-white film. This camera (305mm, f/6 lens) derives its name from the size of individual frames; each frame is approximately 23 cm x 46 cm, with a 40 x 74 degree field-of-view. The frame overlap can be set at up to 80% to allow for the required stereo mapping accuracy. Edge fiducial marks constitute the calibration reference, and the radial distortion is measured to be +-10 micrometers. The camera's framing rate varies from 5 to 45 seconds for use at various altitudes. The spectral range of the camera is 400 to 900 nanometers, and the system resolution is measured to be 100 lines/mm (1000:1 contrast) to 80 lines/mm (2:1 contrast). NASA presently plans to fly the Large Format Camera on an early Shuttle mission. Photography from the first flight will mainly be used by the US Geological Survey and other agencies to update old topographic maps and compile new ones and will also be available for detailed study and resource surveys. Because of the low orbit inclination of the first Shuttle missions (approximately 30°) the covered areas will be restricted to the equatorial zone of the Earth. In addition to its utility in Earth orbit, the Large Format Camera is designed for high-altitude aerial photographs. For example, this camera can provide 1 m ground resolution photographs from an altitude of 20 km. Therefore, the camera opens the way for accurate, high quality photography for local and/or multinational mapping and for detailed land and resource surveys.

19389 (CONF-7804163—(Vol.1), pp 719-727) **NS001MS - LANDSAT-D thermatic mapper band aircraft scanner.** Richard, R.R. (Lyndon B. Johnson Space Center, Houston, TX); Merkel, R.F.; Meeks, G.R. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The technical design and operational characteristics of an aircraft-borne multispectral scanner having thematic mapper bands are described. The purpose of the scanner is to provide low-altitude data in the proposed thematic mapper bands for analysis prior to the launch of LANDSAT-D and to provide underflights subsequent to the launch of the satellite. Design parameters of the NS001Ms multispectral scanner are based on the specifications for the thematic mapper with respect to the spectral band characteristics. The bands included range from 0.45μm to 12.5μm. A single spectrometer disperses the energy to cover the first seven bands from 0.45μm to 2.35μm. An array, employing silicon, germanium, and indium antimonide detectors, is used. The eighth band, containing energy in the 10.4μm to 12.5μm region, is detected by a cooled mercury-cadmium-telluride detector. Variable V/H conditions are compensated for by a variable speed motor which drives the 45-degree scan mirror. Two temperature-controlled blackbodies provide calibrated reference sources, sampled once during each scan. An integrating sphere provides a reference source for the reflective channels, filing the aperture once per scan. Blackbody temperatures and lamp current data are multiplexed with scanner output data. Each channel employs a preamplifier to provide initial video amplification. Gain and level control of video signals are adjustable from the operator's control panel. Each channel is digitized to an 8-bit resolution and is multiplexed with calibration and housekeeping data. Data are recorded in a serial Bi-PHI-L format on magnetic tape. The data format is compatible with data processing techniques used to reduce existing modular multispectral scanner data.

19390 (CONF-7804163—(Vol.1), pp 729-741) **Improving land cover classification by image stratification of LANDSAT data.** Rohde, W.G. (Technicolor Graphic Services, Inc., Sioux Falls, SD). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

LANDSAT digital data have been used to map, inventory, and monitor changes in vegetation resources throughout the world. Supervised, unsupervised, and controlled clustering techniques are commonly used to derive training statistics to classify LANDSAT data with maximum likelihood algorithms. Classification errors can occur when two or more cover types have similar spectral characteristics. Two examples are given of image stratification that resulted in improved classification accuracy. LANDSAT data were used to inventory and map flooded agricultural land in the Red River Valley in North Dakota. Evaluation of initial classification results indicated misclassification between residential areas and flooded agricultural land. Fallow fields and recently planted fields were also misclassified as inundated. The LANDSAT digital data were divided into three strata to minimize the variation in land cover and inundated agricultural land within each stratum. A maximum likelihood algorithm was used to classify the LANDSAT data within each stratum. Evaluation of these results indicated that stratification of LANDSAT data prior to classification of LANDSAT data prior to classification increased classification accuracy by 5 to 10 percent. The stratified classification results were used in a multiphase sampling scheme to estimate that 379,167 ha (sampling error = 4 percent) of agricultural land were affected by flooding. In Alaska, digital analysis techniques were used to classify LANDSAT data into nine land cover classes. Misclassification occurred between water and barren land on steep north-facing slopes and on undulating terrain dominated by tundra. A stratification procedure was used to delineate mountainous, barren areas where a few lakes were present, and misclassification was evident. Barren areas, originally classified as water, were reclassified into the barren land class.

19391 (CONF-7804163—(Vol.1), pp 743-753) **Modeling to estimate and optimize multispectral system performance.** Green, S.L.; Schlesinger, H.L. (Dept. of Justice, Washington, DC). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A description is given of an analytic procedure employed to evaluate the applicability of several multispectral systems to survey large areas for small populations of small plants. Through use of this approach, it was possible to identify the critical system operating parameters and to determine the extent to which existing systems met these parameters.

19392 (CONF-7804163—(Vol.1), pp 755-764) **LANDSAT images of part of the US Trust Territory of the Pacific Islands and other Pacific outlying areas.** Carter, W.D.; DeNoyer, J.M. (Geological Survey, Reston, VA). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

LANDSAT images of the US Trust Territories of the Pacific were acquired. Images of the Western Caroline Islands include Yap, Ngulu Atoll, and the Palau Islands (including Angaur and Babelthaup Islands on the south and the Velasco Reef area on the north). Images of the Samoa Islands include the islands of Tutuila, Manua, Rose, and Swains Island of American Samoa and Savai'i and Upolu of Western Samoa. Fonualei Volcano and the Vava'u Group of the Tonga Islands were also imaged. The data were provided as 70 mm positive film transparencies which were initially screened for land areas and selected images were enlarged to 1:1,000,000-scale film negatives and printed as black and white paper prints. The film

negatives were used in producing color composite transparencies by the diazo process. Using blue for band 4, yellow for band 5, and red for band 7, the diazo color composite shows the exposed island areas as red, shallow water reefs as green and deep water reefs as blue. Comparison with limited soundings on available hydrographic charts of the area demonstrate that the deepest parts of the Velasco reefs were at least 6.3 fathoms (36 ft. or 12 m) below the ocean surface. Computer compatible tapes of some of the best images were selected for experimentation using interactive computer analysis systems.

19393 (CONF-7804163—(Vol.2)) **Proceedings of the twelfth international symposium on remote sensing of environment.** (Environmental Research Inst. of Michigan, Ann Arbor (USA). Center for Remote Sensing Information and Analysis; Natural Resources Management Center, Ouezon City (Philippines)). 1978. 817p. Dep. NTIS, PC A99/MF A01.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

This is the second of three volumes of the proceedings of the Twelfth International Symposium on Remote Sensing of Environment, held 20 to 26 April 1978 in Manila, Philippines. This symposium is part of a continuing program investigating current activities in the field of remote sensing. The meeting is intended to promote increased international cooperation in research, development and application of this technology, and to stimulate an exchange of information on all aspects of this multidisciplinary field through the presentation of reports on work planned, in progress or completed. Presentations include those concerned with the utilization of this technology in various national and international programs as well as in numerous applications for monitoring and managing the earth's resources and man's global environment. Ground-based, airborne, and spaceborne sensor systems and both manual and machine-assisted data analysis and interpretation are included. All papers included in their entirety were abstracted and indexed for EDB/ERA.

19394 (CONF-7804163—(Vol.2), pp 765-774) **Principal component greenness transformation in multitemporal agricultural LANDSAT data.** Abotteen, R.A. (Lockheed Electronics Co., Inc.). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A data compression technique for multitemporal LANDSAT imagery which extracts phenological growth pattern information for agricultural crops is described. The principal component greenness transformation was applied to multitemporal agricultural LANDSAT data for information retrieval. The transformation was favorable for applications in agricultural LANDSAT data analysis because of its physical interpretability and its relation to the phenological growth of crops. It was also found that the first and second greenness eigenvector components define a temporal small-grain trajectory and nonsmall-grain trajectory, respectively.

19395 (CONF-7804163—(Vol.2), pp 775779) **Spacial correlation and its effect upon classification results in LANDSAT.** Tubbs, J.D. (Univ. of Arkansas, Fayetteville); Coberly, W.A. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Most investigators who analyze LANDSAT multispectral scanner data have an intuitive notion that neighboring pixels are not separate independent observations. In fact due to the physical properties of both the sensor and the target scene itself, the observations are highly correlated. However, until recently investigators have assummed that the pixels are independent observations and are used as training inputs for various supervised classification procedures. Basu and Odell (1974) investigated the effect of correlated training samples upon the probabilities of misclassification using Bayes' procedure. They demonstrated that if the training samples were correlated, the usual sample estimates are no longer unbiased and that these biases could effect the classification results, thus possibly explaining the unusual high probabilities of misclassification. They limited their investigation to a particular type correlation structure, that of equicorrelated observations. That is, suppose X/sub i/ and X/sub j/ are any two samples, then the correlation between X/sub i/ and X/sub j/ is R for every i,j, where R is some non-null matrix of appropriate dimension. In their paper, the authors agreed that the equicorrelated correlation structure was probably not the exact structure for LANDSAT data, however, they felt that it was more accurate than assumming the data to be independent. In this study, the effect of a more realistic correlation structure as found in the LANDSAT data was investigated, and its effect upon a supervised procedure, Gaussian-based maximum likelihood classification was studied.

19396 (CONF-7804163—(Vol.2), pp 795-804) **Application of remote sensing to reconnaissance geologic mapping and mineral exploration.** Birnie, R.W.; Dykstra, J.D. (Dartmouth Coll., Hanover, NH). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A method of mapping geology at a reconnaissance scale and locating zones of possible hydrothermal alteration was developed. This method is based on principal component analysis of LANDSAT digital data and is applied to the desert area of the Chagai Hills, Baluchistan, Pakistan. A method for airborne spectrometric detection of geobotanical anomalies associated with porphyry Cu-Mo mineralization at Heddleston, Montana, was also developed. This method is based on discriminants in 0.67 μm and 0.79 μm region of the spectrum.

19397 (CONF-7804163—(Vol.2), pp 805-823) **Example of the merging of LANDSAT, topographic, and aeromagnetic data in a geologic and hydrologic study of a karst region: Claunch, New Mexico.** Fischer, W.A. (Geological Survey, Reston, VA); Orr, D.G.; Greenlee, D.D. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Radiometric LANDSAT, aeromagnetic, and topographic data in digital form of an area in central New Mexico were merged and interpreted to ascertain the value of combining them for geologic studies. The area studied is underlain by sedimentary rocks of Permian age cut by shallow intrusive bodies of Tertiary age. The Permian sedimentary rocks were deposited on an uneven topography of Precambrian igneous and metamorphic rocks, the higher portions of which are exposed throughout the area. The area is characterized by karst topography and internal drainage. Two LANDSAT images of the area were intensively studied, using interactive digital image analyses. In addition, 55 LANDSAT images of the area were examined to ascertain the advantages of repetitive coverage in the study of transient phenomena that might provide clues to geologic structure and lihology. Enhanced LANDSAT images were combined with the aeromagnetic and topographic data. After the radiometric LANDSAT, aeromagnetic and topographic data have been geographically registered, the interpreter can use computer techniques to dynamically display a variety of data combinations for study and analysis. Results of the study indicate that the combining and displaying of multiple data sets makes it easier for the interpreter to relate the significance of different observations. Aeromagnetic data can be correlated readily with surface features and topographic expression. Level-slicing and color-coding allows display of all, part, or combinations of the data sets for ease of analysis. Additional study is needed to determine and evaluate the effectiveness of the computer techniques relative to conventional approaches.

19398 (CONF-7804163—(Vol.2), pp 825-834) **Correlation studies between linear features observed in LANDSAT imagery and earthquake epicenters for a region south of Peking, People's Republic of China.** Vincent, R.K.; Scott, G.N.; Buzby, C.E. IV. (Geospectra Corp., Ann Arbor, MI). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Linear features suspected to be fractures were mapped from a contrast-stretched color composite LANDSAT image of a region south of Peking, P.R.C., which contains an area of intense 1966 earthquake activity. After the linears were digitized, they were segregated into 18 directional categories of 10° azimuth intervals, and the directional fracture length density for each class was calculated for 484 windows of 22.5 km x 22.5 km throughout the frame. Stepwise linear regression was used to find a linear combination of five of these variables that was reasonably well correlated with earthquake epicenter density in the north-central quarter of the frame, where 124 epicenters were located from papers by Yao et al. [1974] and Meyers and Von Hake [1970]. Within the training area, the correlation between the estimated epicenter density resulting from this fracture density model and the actual epicenter density was 0.68. The first two variables selected by the regression method were directional fracture length densities for the azimuth ranges 130 to 140° and 20 to 30°, which agree well with previously published directions for fault-plane solutions of two 1966 epicenters and the direction of an apparent extensional stress system. Several areas of high estimated epicenter densities outside the training area were indicated by the model where few if any epicenters occurred from the experimental data set, of which 94% were from the year 1966. This model might be useful for indicating areas of high earthquake risk which may not have been recognized as high risk areas by recent seismic data alone, though there is insufficient data available at this time to test the validity of the model outside the training area.

19399 (CONF-7804163—(Vol.2), pp 857-866) **Application of LANDSAT imagery in the geological and soil investigations in the central Western Desert, Egypt.** El Shazly, E.M.; Abdel Hady, M.A.; El Shazly, M.M.; El Ghawaby, M.A.; Khawasik, S.M.; Haraga, A.A.; Sanad, S.; Attia, S.H. (Remote Sensing Center, Cairo, Egypt). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The investigated part in the central Western Desert of Egypt covers a large area between latitudes 29°N and 26°N, and it is

limited to the east by the River Nile and to the west by the Egyptian-Libyan border. The northern boundary of the area lies at distances ranging from 200 to 600 km to the south of the Mediterranean Sea and its western boundary is separated by a maximum distance of some 580 km from the River Nile. Mapping and studies were carried out for the investigated part of the central Western Desert on a scale of 1:500,000 through LANDSAT imagery interpretation combined with adequate field work, where hundreds of soil profiles and lithostratigraphic sections have been sampled, and laboratory analyzed. The first generation of the maps produced includes those of the soils, geological and environmental units, structural lineations, and surface drainage. Computation of the data of the structural lineations and surface drainage maps has led to the construction of a lineation density map as well as drainage density and drainage basins maps respectively. This multidisciplinary approach has led to the choice of locations for desert development in the area of investigation and to the arrangement of the locations so chosen according to priorities.

19400 (CONF-7804163—(Vol.2), pp 867-876) **Remote detection of reinforced-concrete delamination in bridges by infrared thermography.** Clemena, G.G.; McKeel, W.T. Jr. (Virginia Highway and Transportation Research Council, Charlottesville). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Concrete delamination in highway bridges is a major problem in marine environments and climatic areas where deicing salts are used. Unfortunately, locating delamination in bridge decks for repair is not satisfactorily done with conventional deck evaluation techniques. Locating delamination in other, less accessible parts of a bridge is even more difficult. In an attempt to develop a better technique for locating delamination, the use of infrared thermography was evaluated. The rationale behind the use of thermography for detecting delamination and a brief discussion of some experimental results are presented.

19401 (CONF-7804163—(Vol.2), pp 887-898) **Quantitative assessment of change in land formations along the coastline of Bangladesh.** Pramanik, M.A.H. (LANDSAT Task Force, Dacca, Bangladesh); Chaudhury, M.U.; Ali, M.M., MacLeod, N.H.; Polcyn, F.C.; Roller, N.E.G.; Lyzenga, D.R. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The purpose of this project was to study the phenomenon of land accereton in the Bay of Bengal. The approach used was the digital processing of computer compatible LANDSAT data. A change detection methodology was developed and used to determine whether a net gain or loss of land has occurred between 1972 and 1977. A turbidity map was prepared to provide insight into the processes responsible for new land build up and distribution.

19402 (CONF-7804163—(Vol.2), pp 899-905) **Small grant program for remote sensing technology transfer.** Wagner, T.W.; Lowe, D.S. (Environmental Research Inst. of Michigan, Ann Arbor). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

In 1974 USAID initiated an experimental small grant program directed at transferring appropriate remote sensing technology to developing countries. The program to date has provided 13 grant awards and technical assistance on a competitive basis to investigators in 11 countries: Bolivia, Chile, Peru, Haiti, Lesotho, Zaire, Bangladesh, Pakistan, Philippines, Sri Lanka, and Thailand. The individual results of the program have been generally successful; eight of the ten grants completed have provided information actively being used in national development planning. Equally important, grant projects have generated an interest on the part of local decision-makers to continue to use the remote sensing technology. Ingredients for a successful grant project were found to be high-level management support, an enthusiastic and resourceful investigator (grantee), and involvement in programs of prime concern to the country. While advanced technology was not necessary for the projects to obtain useful information, such technology was not excluded where appropriate. The results of this program indicate that small grants, while not always successful, are in general an effective mechanism for transferring remote sensing technology.

19403 (CONF-7804163—(Vol.2), pp 917-926) **Applications of modeling to analysis and processing of Landsat data.** Malila, W.A.; Gleason, J.M.; Sadowski, F.G.; Cicone, R.C.; Crist, E.P. (Environmental Research Inst. of Michigan, Ann Arbor). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Modeling of scene, atmospheric, and sensor characteristics can greatly aid in the development of remote sensing techniques for application in Earth resource inventory programs. Uses of modeling in the analysis and processing of LANDSAT data for agricultural and forestry applications are illustrated. The Suits bidirectional reflectance model for vegetation canopies was employed in calculating reflectance values for the four LANDSAT spectral bands, under a variety of canopy and observation conditions. First, relationships between characteristics of developing wheat fields and associated reflectances were investigated. Canopy density, soil brightness, and sun angle effects are described. In addition, coincident measurements of crop reflectance and LANDSAT signals were compared using regression analysis techniques and relationships are presented. Secondly, the model was applied to forest situations both to help establish the extent to which LANDSAT might provide direct information about conditions occurring beneath forest overstories and to help develop methods for reducing the effects of terrain slope and aspect in the processing of LANDSAT data. Landsat reflectance values were computed for a wide range of coniferous forest overstory/understory combinations under 15 different topographic orientations for a total of 1260 cases. An analysis of these data is presented. Finally, a relationship based on model calculations was used to adjust LANDSAT signal values and was found to reduce topographically related variability and improve subsequent classification performance. The adjustments were determined from values of spatially registered topographic data.

19404 (CONF-7804163—(Vol.2), pp 927-942) **Improving forest cover classification accuracy from LANDSAT by incorporating topographic information.** Strahler, A.H. (Univ. of California, Santa Barbara); Logan, T.L.; Bryant, N.A. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Accuracies of computer classification of species-specific forest cover types from LANDSAT imagery can be improved by 27 percent or more through incorporating topographic information from US Geological Survey digital terrain tapes registered to multidate Landsat imagery. Consisting of the set of elevations of each pixel, from which slope orientation (aspect) of the pixel is also derived, the topographic information improves classification accuracies because many common forest tree species have preferred elevation ranges and slope aspects. These preferences allow the separation of forest cover types which have similar spectral signatures but different species compositions. Final average classification accuracy for the species-specific cover classes was 85% as evaluated by a separate random sample.

19405 (CONF-7804163—(Vol.2), pp 943-945) **Procedural guide for vegetation analysis.** Messmore, J.A.; Vogel, T.C. (Army Engineer Topographic Labs., Fort Belvoir, VA). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The US Army has a requirement for a relatively simple, easy-to-use vegetation mapping system that can be applied worldwide. To fulfill this need, 13 vegetation parameters needed to define the vegetation of a given area were identified. The mapping system that evolved from these parameters is not based on a floristic or detailed physiognomic classification system; but rather, it is primarily based on vegetation height and general type, easily photo-measured parameters. To implement this vegetation mapping system, procedures were developed that include photographic interpretation techniques and reference materials of interest to the civilian community. These procedures define the 13 vegetation parameters (data elements) and provide the step-by-step means for extracting, reducing, and recording pertinent information. Given the constraint that little or no ground data collection is feasible, three alternative information sources are treated. They are military topographic maps, literature sources, and aerial imagery.

19406 (CONF-7804163—(Vol.2), pp 947-955) **US of LANDSAT in the study of forest classification in the tropical jungle.** Danjoy, W.A. (Oficina Nacional de Evaluacion de Recursos Naturales, Lima, Peru); Sadowski, F.G. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The procedures and results of a study to determine the feasibility of using LANDSAT data for identifying and locating Aguaje Palm and other forest associations within lowland areas of the tropical forest region of eastern Peru are presented. Two test sites were selected for analysis; one in the vicinity of the city of Iquitos and the second along the northern reaches of the Maranon River. The application of manual interpretation and digital processing techniques each demonstrated capabilities for mapping Aguaje and other forest associations that appeared to correspond closely to drainage conditions that prevail in low jungle areas. Classification maps derived from digital processing were considered to be a more accurate portrayal of low jungle vegetation patterns because of more precise boundary location and greater detail in complex scene areas. Implementation of a newly-developed, multi-element classification rule into the digital processing procedure is discussed. LANDSAT capabilities presented offer the potential for providing a level of information that would constitute a complete and up-to-date first stage reconnaissance survey over the low jungle areas of the Peruvian Amazon Region.

19407 (CONF-7804163—(Vol.2), pp 957-974) **Electromagnetic scattering properties of soils and snow.** Ellerbruch, D.A.; Jesch, R.L.; Jones, R.N.; Bussey, H.E.; Boyne, H.S. (National Bureau of Standards, Boulder, CO). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The electromagnetic scattering properties of soils and snow are being measured in situ under natural environmental conditions. A physical analysis is done at each test site to determine the physical properties of the sample for correlation with its electromagnetic signature.

19408 (CONF-7804163—(Vol.2), pp 975-990) **SURTRACE/sup TM/, an airborne geochemical system.** Barringer, A.R.; Davies, J.H.; Daubner, L. (Barringer Research Ltd., Rexdale (Toronto), Ontario). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The SURTRACE technique has been developed for rapid, multi-parameter exploration for both shallow and deep mineral deposits, geothermal regions, and hydrocarbon accumulations occurring in a wide range of environments. Airborne, vehicle-mounted, and man-portable versions of the equipment are available giving the system a remarkable degree of flexibility in terms of high-speed coverage of terrain. Sampling speeds of up to 50 mph can be achieved in helicopter cross-country traversing, and speeds of 20 to 30 mph in vehicle traversing of section roads. The system operates in a newly recognized geochemical horizon - the surface micro-layer - and has proven to have important applicability, not only in hard-rock exploration for minerals, but also for use in tracing the migration paths of solutions and volatiles in geothermal environments and sedimentary basins. In the latter application, the successful detection of deeply-buried uranium, hydrocarbon, and geothermal occurrences has been established during extensive testing and evaluation of the system over many known deposits and fields. An airborne gamma-ray spectrometer and one-gamma magnetometer are normally flown with the SURTRACE system, thereby providing valuable complementary geophysical data that aids in the interpretation of the geochemical information.

19409 (CONF-7804163—(Vol.2), pp 1009-1012) **Application of conventional aerial photography and interactive computer graphics in mapping natural phenomenon.** Kuyper, W.H. (Florida Dept. of Transportation, Tallahassee). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The use of remote sensing imagery by the Florida State Department of Transportation for mapping and evaluating land use and land cover is reviewed. Steps in acquiring and installing equipment are traced, and techniques used for data acquisition, processing, and storage, as well as plotting methods are discussed. (JGB)

19410 (CONF-7804163—(Vol.2), pp 1027-1035) **Use of remote sensing to quantify construction material and to define geologic lineaments, Dickey-Lincoln School Lakes Project, Maine.** McKim, H.L. (Army Cold Regions Research and Engineering Lab., Hanover, NH); Merry, C.J.; Blackey, E.A. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Fourteen surficial geology units were delineated in a 2850-km^2 area in northern Maine from a photomosaic prepared from 1966 black and white photography (scale 1:33,600). These units included: alluvial fan, alluvial terrace, esker, floodplain, glacial moraine, kame, kame terrace, outwash, outwash terrace, bedrock, till, till over bedrock, wet outwash and wet till. The surficial geology units were field checked and then updated from the field reconnaissance. The depths of the surficial geology units were estimated utilizing borehole data, field measurements and seismometer data. The areal extent of each surficial geology unit within a 6.4-km radius for the three dike sites and a 9.6-km radius for the main dam site was quantified using a planimetric color densitometer. The volumes of construction material were computed based upon these areal determinations and estimated depths. Considerable time was saved using remote sensing techniques to obtain this information instead of conventional ground surveys. The volume estimates obtained were compared with the estimates of required construction material computed during the initial design phase. The comparison showed that more material could be found within the prescribed area around the dam and dike sites than was required for construction. The lineaments observed on the Landsat imagery (scale 1:500,000) provided a sound base for analysis of possible tectonism in the Dickey-Lincoln area. It is believed that the east- and northeast-trending lineaments in this area are thrust faults dipping 45° to the northeast. The north-trending and N60°W lineaments are probably strike-slip normal and reverse faults dipping 80° to nearly vertical. Future movement along these faults should be negligible.

19411 (CONF-7804163—(Vol.2), pp 1037-1051) **Targeting exploration for nickel laterites in Indonesia with Landsat data.** Taranik, J.V. (Geological Survey, Sioux Falls, SD); Reynolds, C.D.; Sheehan, C.A.; Carter, W.D. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Many small islands between Borneo and New Guinea have been investigated for occurrence of nickel laterites (Reynolds and others, 1973). Ground-based exploration is costly and difficult because of the remote location, dense vegetation, and the ubiquitous lateritic soils which develop over diverse types of iron-rich rocks. Ground-based investigations of islands west of Waigeo Island have documented landscape cover conditions related to nickel laterite occurrence (Reynolds and others, 1973, p. 317). Vegetation is often less dense and stressed. Plant species present in areas having laterites at or near the surface may be different from those in adjacent non-laterite areas. LANDSAT Multispectral Scanner (MSS) computer compatible tape (CCT) data were analyzed for two islands near Waigeo. Areas of known laterite occurrence on Gag were analyzed using an interactive multispectral analysis system. Contrast enhancement techniques allow areas having laterites to be better identified because more red lateritic soil is exposed in those areas and they appear bright green on enhanced false-color images. Areas not having laterites have dense, healthy vegetation and appear bright red on imagery. A parallele piped classification algorithm was employed in a supervised mode to determine the integrated spectral response from vegetation and lateritic soil over the laterite areas. The enhancement and classification techniques employed in areas on Gag were extended to areas on Kawe, and similar signatures for sparse and stressed vegetation and exposed red bare soil were identified.

19412 (CONF-7804163—(Vol.2), pp 1073-1081) **Problems and concepts in remote sensing of land use.** Link, L.E.; Struve, H. (Mobility and Environmental Systems Lab., Vicksburg, MS). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The basic phenomena that generate the information content of remote sensing images are examined, and ways in which these phenomena affect the performance of programmed interpretation techniques are addressed. An interactive programmed interpretation procedure that combines advantages of both training area and clustering image processing concepts is presented. Concepts for enhancing the performance of programmed interpretation techniques are presented and discussed.

19413 (CONF-7804163—(Vol.2), pp 1083-1090) **Identification and delineation of urbanized areas using LANDSAT data.** Dietrich, D.L. (General Electric Co., Beltsville, MD); Lachowski, H.M.; Christenson, J.W. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The US Bureau of the Census is responsible for conducting a decennial population census. As part of each census, the Bureau must establish an urbanized area boundary within each Standard Metropolitan Statistical Area in the United States. The conventional techniques currently being used to update the urban boundaries are costly and time-consuming. In addition, recent legislation and the steady expansion of the urban areas emphasize the need for more frequent boundary updates. The search for improved techniques has led to a program that will assess the utility of LANDSAT data for urbanized area delineation. The program, titled the Census-Urbanized Area Application System Verification and Transfer (ASVT) project, is a cooperative effort of the National Aeronautics and Space Administration and the US Bureau of the Census. Though LANDSAT data cannot be used to count structures or people, it can be used to provide a new perspective on the character of urban land cover and urban growth. The objective of the test phase of the ASVT, now underway, is to develop processing techniques and output products that meet urban fringe zone delineation requirements. A variety of processing approaches will be evaluated during the test phase. One of the approaches that will utilize an interactive processing system to produce digital enhancement and classification results is evaluated. The approach will ultimately be applied to five test cities and the results will be evaluated by the Census Bureau. The successful completion of the test phase will lead to a larger semi-operational phase that will be evaluated during the 1980 Census. The operational role of satellite remote sensing will be formulated in the post-1980 technology transfer phase of the ASVT.

19414 (CONF-7804163—(Vol.2), pp 1149-1154) **Wheat production forecasts using LANDSAT data.** Nalepka, R.F.; Colwell, J.E.; Rice, D.P. (Environmental Research Inst. of Michigan, Ann Arbor). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

An approach which uses LANDSAT data as one of the information sources to aid in the forecast of the production of wheat is discussed. Comparisons are made between ground-based, agromet model-based, and LANDSAT-based approaches for winter wheat yield forecasts in the US Southern Great Plains. Results of applying a LANDSAT direct production forecast approach are presented,

and a proposed combination model is described which is designed to utilize both LANDSAT and agromet information.

19415 (CONF-7804163—(Vol.2), pp 1155-1166) **Delineation of soil-landscapes in the Sudd region of Sudan on LANDSAT imagery.** Worcester, B.K.; Moore, D.G. (South Dakota State Univ., Brookings). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A multistage investigation was undertaken in the upper Nile Region of southern Sudan using temporal LANDSAT imagery, low level aerial reconnaissance and ground survey to inventory and delineate the soil resources of the 167,474 km^2 study area. Five major soil-landscape units were delineated. The synoptic view of LANDSAT imagery was used to construct interrelationships between the various units. This permitted accurate interpretations of patterns on the imagery which related to soil-landscape conditions.

19416 (CONF-7804163—(Vol.2), pp 1167-1185) **Analysis of the dynamics of shifting cultivation in the tropical forests of northern Thailand using landscape modeling and classification of LANDSAT imagery.** Miller, L.D. (Texas A & M Univ., College Station); Nualchawee, K.; Tom, C. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Landscape modeling is the process of overlay and analysis of a large number of multiple spatial variables extracted from maps, airphotos, LANDSAT imagery and other remotely sensed data. Its application to this problem has employed a data base containing 103 spatially registered variables. These variables have been assembled to model a site of 292.2 square kilometers at a 1 hectare resolution in the tropical forests of northern Thailand which are subjected to the dynamic practice of shifting cultivation. Recent changes in land cover measured with 4 dates of sequential airphoto interpretation maps were used to model the overall trends and spatial trends in 6 forest and 3 agricultural land cover types occurring in the forest area. Computer comparison of the changes in 5 consecutive anniversary date LANDSAT images for 1972 through 1977 was completed with this data base to determine the usefulness of this simple image analysis approach for monitoring the dynamic changes in this forest cover. LANDSAT image classification was also tested within the context of the landscape model to determine the contribution of spatial overlays of ancillary data to final map classification accuracy for the 9 land covers. Topographic overlays were evaluated (slope, aspect, elevation, and distance to drainage) as well as cultural feature overlays (distance to roads and trails, permanent housing, and temporary huts). Stepwise discriminant analysis was employed as the classifier with 3 types of training sets (rectangular, aspect, and grid sampled training sets). Two assumptions of the a priori probabilities of occurrence of the 9 land covers within the site were also tested with this classifier, i.e., equal a priori probability of occurrence and probabilities proportional to the known occurrence of each cover type.

19417 (CONF-7804163—(Vol.2), pp 1187-1198) **New developments in tropical forest inventories.** Sayn-Wittgenstein, L. (Forest Management Inst., Ottawa, Canada). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Applications of satellite remote sensing to tropical forest inventories have emphasized the need for efficient methods to collect more detailed information. Recent developments in tropical applications of large-scale aerial photography are therefore relevant. The developments, which are reviewed, include tests of an airborne radar altimeter and camera system, evaluations of photo specifications and attempts to identify tree species on aerial photographs. Accurate description of tree crowns is a prerequisite for identification. Terms used in describing crowns are defined and illustrated.

19418 (CONF-7804163—(Vol.2), pp 1199-1205) **Transferring remote sensing technology: activities at TAC.** Morain, S.A. (Univ. of New Mexico, Albuquerque). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The Technology Application Center (TAC) at the University of New Mexico has a complete line of products and services designed to assist smooth and efficient transfer of remote sensing technology. The range of activities has evolved to meet the requirements of a varied user community which includes private industry, educators, government agencies and individual citizens. Technology transfer begins with the identification of user needs and problems, for which appropriate technical information, maps, and imagery are retrieved and disseminated. Depending upon specific user intent, these data are reformatted, condensed, or interpreted to answer specific questions; or, they may be delivered without additional value added. Beyond data retrieval, there is a need for demonstration, on-site training or other educational efforts to convey processes, techniques, and procedures. Some users desire the application of existing technology to their specific geographic area or the modification of that technology to fit a resource problem other than that for which it was originally designed.

19419 (CONF-7804163—(Vol.2), pp 1207-1217) **Image registration for thermal inertia mapping, and its potential use for mapping of soil moisture and geology in Australia.** Pratt, D.A.; Ellyett, C.D. (Univ. of Newcastle, Australia). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Production of a thermal inertia image requires the integration of two thermal infrared images, one predawn and one post-midday, a panchromatic image and a thermal inertia model. The whole process is a lengthy multi-stage procedure which requires considerable manual supervision. It has been made as automatic as possible to allow for future application on a routine basis. Detailed knowledge of the extent and cause of diurnal surface temperature fluctuations is necessary for a full understanding of thermal inertia mapping. Computer thermal inertia models have therefore been developed by simulating the influence of many ground physical properties and meteorological conditions. Real meteorological data can also be fed into the models and for this purpose a microclimatological station has been established. Results are now given which allow the prediction of characteristic variations in soil thermal properties for variations in composition, porosity and moisture content. Results obtained in this way have been used to examine the potential applications of the remote determination of thermal inertia for both soil moisture and geological mapping. Mapping of relative changes in soil moisture should be possible with limited, subjective geological interpretation of soil type and porosity. Mapping of soils in semi-arid environments, based upon mineralogical content, is not directly possible using thermal inertia mapping techniques. However it should be possible to detect soil changes based upon porosity and residual soil moisture content which are functions of the mineralogical content. This should provide a valuable addition to the standard mapping methods currently in use.

19420 (CONF-7804163—(Vol.2), pp 1219-1227) **Five channel MSS for aircraft platform.** Joseph, G.; Kamat, D.S. (Indian Space Research Organization, Ahmedabad). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Application of remote sensing for earth resources survey is one of the major activities of the Space Applications Centre of the Indian Space Research Organization (ISRO). ISRO has developed a five channel multispectral scanner (MSS). The present MSS instrument has a capability to choose any four spectral band between 0.5 to 1.1 micron and one channel in the 8 to 12 micron band. The MSS instrument has a field of view of 5 milliradian and a spatial resolution of 15 meter when flown at a height of 3 kmsN. The instrument has some unique features incorporated for operational needs. A checkout facility enables the operator to monitor the MSS to give the GO/NO-GO decision before the mission starts. The instrument is mounted on a Dakota DC-3 aircraft and is being used to collect data for various user agencies in India. The work in respect of data preprocessing and the final data product is also discussed.

19421 (CONF-7804163—(Vol.2), pp 1229-1239) **Analog/digital image processing system TIAS.** Shimoda, H.; Sakata, T. (Tokai Univ., Kitakaname, Hiratsuka, Japan). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

An analog-digital hybrid image processing system named Tokai Image Analysis System (TIAS) was developed. It is composed of a minicomputer, conventional computer peripherals and image I/O's. Its special feature is the emphasized introduction of human pattern recognition ability to the processing.

19422 (CONF-7804163—(Vol.2), pp 1267-1277) **Analysis of a transformation model of satellite radiances into reflectances.** Rochon, G. (Universite Laval, Quebec, Canada); Audirac, H.; Ahern, F.J.; Beaubien, J. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Many difficulties in interpretation of LANDSAT data often arise from the fact that radiances are used in the analysis of the data. Various techniques have been developed to transform those uncorrected measurements into a variable independent from external factors, such as sun illumination angle, path radiance, etc. Usually some type of measurement must be done in synchronism with the passage of the satellite. The first results of a transformation model of radiances into reflectances using only lakes as standard reflectance targets are presented. The basic concept on which this model is based is that volume reflectances of most oligotrophic lakes vary randomly in time. With a large number of such lakes within a LANDSAT image, or within any other similar form of passive remote sensing data, a statistical analysis of these targets will thus give a global estimation of the variation from frame to frame of all the external factors. The results given by this model applied to four different LANDSAT images are compared with ground truth data.

19423 (CONF-7804163—(Vol.2), pp 1289-1298) **Geologic and hydrogeologic study in the Tamilnadu State of South India using LANDSAT data.** Thillaigovindarajan, S. (PWD (Groundwater) Government of Tamilnadu, Madras, India); Andrawis, A.S. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A detailed image analysis of a selected test area in Tamilnadu State, South India, was conducted to investigate the applicability of LANDSAT data for hydrogeologic studies. A false-color mosaic and a reconnaissance map of the geology and lineaments of Tamilnadu State, South India, were prepared. The LANDSAT multispectral data were visually interpreted for hydrogeological information. Correlation of the existing water wells with the lineaments interpreted and mapped showed that the locations of high yield wells were related to the lineaments.

19424 (CONF-7804163—(Vol.2), pp 1299-1306) **Use of satellite imagery to assess forest deterioration in eastern Thailand.** Klankamsorn, B. (Royal Thai Forest Dept., Bangkok, Thailand). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Satellite imagery is useful in forestry for gathering up-to-date data over large areas. Comparison of satellite photographs taken in 1972 and 1975 shows that the forest area of Thailand's eastern region is decreasing at an average of 5.3% per year. Total forest area of the region is 12,631 km^2, or 33.5% of the total area.

19425 (CONF-7804163—(Vol.2), pp 1329-1338) **Application of LANDSAT data to monitor desert spreading in the Sahara region.** Brera, A.M.; Shahrokhi, F. (Univ. of Tennessee Space Inst., Tullahoma). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Each year the encroachment of the Sahara Desert upon previously arable land lays waste to vast areas in Africa. At the startling rate of thirty miles per year, this desert dune movement engulfs an average of eighteen feet per hour in its drive over the continent. Major programs of sand fixation and afforestation have been undertaken by many African countries. These progressive efforts should be supported by the analysis and definition of factors relating to dune movement, formation, and growth. This work is best performed by analysis of satellite imagery of both functional and economic reasons. Analysis of the imagery available from LANDSAT 1 and 2 for the period between 1972 to 1977 using digital and analogue techniques over selected test areas in the Libyan Desert has been undertaken. The first step in the use of LANDSAT imagery is to employ it for the identification and mapping of distinct units on the ground. This was carried out using Band 5 imagery, which contains more information suitable for our purpose than do the other bands. By proper registration, images taken at different times are then subtracted electronically from each other to show the direction and areas covered by desert movement for the past five years. These findings were supported by ground truth data obtained from the selected sites in the form of topographic, geologic, and soil maps, aerial photographs, and meteorological information. The results of this analysis indicate that global surveillance of the status of dryland ecosystems and of land use can be achieved most economically through the use of LANDSAT imagery if proper image analysis techniques are used.

19426 (CONF-7804163—(Vol.2), pp 1339-1348) **Remote sensing of squatter areas in Hong Kong.** Lo, C.P. (Univ. of Hong Kong). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Sequential aerial photography in color, color infra-red and black-and-white for 1944, 1956, 1967, and 1975 was employed to map changes in squatter housing and land use in N.E. Kowloon of Hong Kong. Delimitation of the squatter area boundaries, determination of squatter structure density, estimation of squatter population, evaluation of environmental changes and a study of the process and form of squatter settlement growth were undertaken. It was found that photographic remote sensing is capable of generating detailed data on land use and processes of squatter settlement growth, which can be usefully employed for more positive solution of the squatter problem by planners.

19427 (CONF-7804163—(Vol.2), pp 1349-1365) **Thematic map of Lombok Island from LANDSAT computer compatible tapes.** Kalensky, Z.D. (Dept. of Fisheries and the Environment, Ottawa, Canada); Darmoyuwono, K.; Potts, T.F.; Michino, T. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Described is the methodology and presented are the results of vegetation and land use mapping at 1:250,000 scale of Lombok Island, Indonesia. Acquisition and interpretation of ground cover data were based on multistage remote sensing and computer-aided classification of LANDSAT multispectral images recorded on computer compatible tapes. Two LANDSAT scenes, recorded in October 12, 1972 and June 21, 1973, were selected as the main source of vegetation and land use data. They were supplemented in training areas by 1:50,000 black and white aerial photographs, low altitude color oblique photographs taken from hand held cameras and by spot field checks on the ground. Selection of eight classification categories was preceded by unsupervised classification of the October scene. Supervised classification of the two LANDSAT scenes and of their multidate combination provided input for compilation of thematic overlay, which was overprinted onto the base photomap. The result is a three-color vegetation and land use map at 1:250,000 scale. Classification (statistical) accuracies of the eight categories ranged from 63% to 93%, the mapping (positional) accuracies ranged from 51% to 93%. Discussion of some aspects of computer-aided image processing applied to vegetation and land use mapping in tropical regions, as well as the cost estimates, conclude the paper.

19428 (CONF-7804163—(Vol.2), pp 1391-1400) **LANDSAT inventory of the agricultural and forest resources in Bangladesh.** Chaudhury, M.U. (LANDSAT Task Force, Dacca, Bangladesh); Azim, A.; Hossain, Q.T.; Choudhury, J.K.; MacLeod, N.H.; Polcyn, F.C.; Colwell, J.E.; Roller, N.E.G.; Haack, B.N. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The primary purpose of this project is to investigate the usefulness of LANDSAT data in Bangladesh for two tasks: an inventory of boro rice and a forest inventory. The preliminary conclusions of the project are that: LANDSAT data will be useful for making an inventory of boro rice; and the spectral signatures of the various forest classes investigated are a complex function of the species composition, the stand density, and the background characteristics, so that there is not a unique association of LANDSAT signatures with conventional forest inventory classes.

19429 (CONF-7804163—(Vol.2), pp 1401-1407) **LANDSAT assisted forest inventory of the Philippine Islands.** Lachowski, H.M. (General Electric Co., Beltsville, MD); Dietrich, D.L.; Umali, R.; Aquino, E., Basa, V. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A nationwide forest inventory of the Republic of the Philippines was performed using LANDSAT digital data. Because of the increasing demand on the forest resources of the Philippines, the decision was made to update the forest inventory of the 300,000 km^2 nation. Thirty LANDSAT scenes provided the data source for identifying the geographic distribution of forest resources and the area covered by major forest types. Digital LANDSAT data was processed at General Electric's Image Processing and Analysis Center. The data were classified into major forest categories, including full and partial canopy dipterocarps, mangrove, mossy or high elevation forests, and non-forest wetlands. Ground truth was collected and used to guide and verify the classification process. Inventory results were presented as: color thematic maps highlighting the location of major forest classes, and area measurements of these forest classes. Area measurements were summarized for major political subdivisions. This time and cost-effective inventory was conducted over a four-month period. The results provide a synoptic view of the nation's total forest resources and can serve as a baseline for more intensive forest management programs in the Philippines.

19430 (CONF-7804163—(Vol.2), pp 1409-1413) **Use of color infrared aerial photography to detect plants attacked by tropical fruit flies.** Hart, W.G.; Ingle, S.J.; Davis, M.R. (Federal Research, Weslaco, TX). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The density and distribution of various host plants of tropical fruit flies can be detected with color infrared aerial photography. Studies conducted in Hawaii, El Salvador, and Mexico demonstrated that hosts of melon flies, Oriental fruit flies, and Mediterranean fruit flies can be identified at a scale of 1:10,000. This work offers considerable promise for improved survey, control, and eradication programs for these pests. The technique is particularly useful in rugged, inaccessible terrain, which fruit flies frequently inhabit. The procedure can be applied for approximately 0.4 cents per acre.

19431 (CONF-7804163—(Vol.2), pp 1415-1419) **New Brunswick potato area estimation from LANDSAT.** Mosher, P.N. (New Brunswick Dept. of Agriculture and Rural Development, Fredericton); Ryerson, R.A.; Strome, W.M. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The design and testing of a remote sensing-based potato area estimation procedure in the New Brunswick potato belt is reported. Two methods were considered: visual interpretation of high altitude color airborne imagery at a scale of 1:112,500, and digital analysis of LANDSAT data using the Canada Center for Remote Sensing Image Analysis System (CIAS) which includes a highly modified Image 100. The first is planned as a back-up to the second in the event of cloud cover or satellite failure. To evaluate accuracies

obtained by these methods, detailed ground data, including crop type and field size, were collected in 1974 and 1975 for each field in an area of 125 km^2. The area typically contains 3000 to 4000 hectares of potatoes. The success in initial tests using 1974 data (94% accurate potato area estimates using aerial photographs and 90% accurate potato area estimates using digital analysis of LANDSAT data) led to additional tests and application of satellite monitoring to the entire potato belt. In the more comprehensive second set of tests it was found that in sub-test areas located within five miles of the training sample used in the digital analysis of LANDSAT data, potato area estimates were consistently over 90% accurate. As one attempted to extend the signature derived from the original training set, accuracies dropped to below 80% and retraining was necessary. The methods and criteria used to retrain the CIAS without additional ground data are described. The area estimate for the entire potato belt was 84.5% accurate and within the user's requirements. The total costs for each method are detailed. They both require ground work for provision of training data. The back-up airborne-based estimate is up to ten times more costly than satellite methods but is more accurate and can be as timely.

19432 (CONF-7804163—(Vol.2), pp 1421-1430) **Some recent developments in remote sensing instruments and measurement systems.** Velten, E.H.; Gilg, W.; Rausch, G. (Dornier System GmbH, Space Program Dept., Friedrichshafen, Germany). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Within the German and European Remote Sensing Programs investigation and definition of measurement systems have been performed for several years. Under contracts from the European Space Agency and the German Ministry of Research and Development a number of conceptual studies concerning such measurement systems for various application and research areas have been performed. These include typical system studies as a geosynchronous Multidisciplinary Earth Observation Satellite System (MEOS) with a high resolution optical sensor for continuous observation of dynamic features of the earth surface and the atmosphere, a sunsynchronous polar orbiting Earth Observation Satellite (ERDSAT) in low orbit, and an early Spacelab Demonstration Mission with a nearly complete set of instruments for atmospheric and earth surface investigations. In addition several specific instruments have been defined in phase A and phase B studies such as a multidisciplinary LIDAR instrument for measurement of atmospheric aerosols and trace gas concentrations and a Multichannel-Multispectral Polarimeter for determination of ice and water content of clouds. Space hardware development of a Microwave Remote Sensing Facility to be flown on the First Spacelab Mission in 1980 has started in 1977 after successful flights of an airborne Two-Frequency-Scatterometer. This experiment is considered to be an important contribution to further development of microwave sensor systems to be flown on Spacelab and future European remote sensing satellites.

19433 (CONF-7804163—(Vol.2), pp 1441-1450) **Integration of LANDSAT data and national land data system.** Murai, S.; Tateishi, R.; Okuda, T.; Matsuoka, R. (Univ. of Tokyo, Japan). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Japanese national land data have been and are now collected and digitized for land use planning by the central government and/or local government. National land data which have been digitized include mesh data such as terrain data, land form, land condition and landuse, and line segment data such as coast lines, rivers, and administrative boundaries. The objectives of this study were to make registration of LANDSAT MSS CCT data onto the national data system, to make pseudo stereoscopic LANDSAT images by combining with digital terrain data, and to extract environmental informations such as vegetation cover and cultural feature cover from a model of function with respect to LANDSAT MSS data and land use data. It is concluded that geometric corrections enabling registration of LANDSAT MSS CCT data onto the national data system can be accomplished with high accuracy within one pixel. Pseudo stereoscopic LANDSAT images can be produced by combining the digital terrain data with the geometrically corrected LANDSAT data. This may be well applied to geology and land form analysis. Vegetation cover can be well estimated by multi-regression model with respect to average of LANDSAT data belonging to 500 meters mesh and the corresponding measured vegetation cover with the accuracy of $r = 0.92$ in multi-regression coefficient. Vegetation cover map can be produced by applying the multi-regression model determined in the small area of test site to the wide area outside of the test site. Cultural feature cover can also well be estimated by multi-regression model with the accuracy of $r = 0.86$ in multi-regression coefficient. An urbanization index was proposed to combine vegetation cover with cultural feature cover in the canonical regression model. The results obtained show that urban environment would be better evaluated by the combined index than vegetation cover either cultural feature cover along. (JGB)

19434 (CONF-7804163—(Vol.2), pp 1451-1460) **Airborne remote sensing project in Japan - JAFSA Project.** Toyota, H. (Univ. of Tokyo, Japan); Ochiai, H.; Fujimura, S.; Yasuda, Y.; Iisaka, J.; Koyama, T.; Aikoh, T. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The Japan Foundation for Shipbuilding Advancement (JAFSA) Project, the biggest airborne remote sensing project in Japan, is described from two aspects. One is project activities including organization, research activities, and applications. Technical aspects, including newly developed data acquisition subsystems and data processing subsystems, are also described.

19435 (CONF-7804163—(Vol.2), pp 1461-1470) **Scene registration accuracy in LANDSAT time sequencing.** Lodwick, G.D. (Univ. of New South Wales, Sydney, Australia). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A sequence of 7 LANDSAT images extending from June 3 through to December 18, 1976 is being analyzed in order to investigate seasonal changes in ground and vegetation cover in the upper Hunter Valley region of New South Wales. The study area comprises approximately 1/30th of the TAMWORTH scene, and analysis of the Multi Spectral Scanner (MSS) digital tapes is being carried out using the CDC CYBER 72 computer at the University of New South Wales. The method of adjustment for each scene involved complete cubic polynomials, spatially resected onto 21 common control points, chosen from natural features in the survey area. Errors in selecting the control points in the image were eliminated by using the redundancy introduced by the seven scenes. The residual adjustments indicated errors in the ground coordinates of the control points and these were corrected using aerial photographs and field measurements. The results showed that for individual scenes, vector errors in the adjustments ranged from 24 to 47 meters. By calculating differences at 10 check points not forming part of the adjustments, misregistration between all possible pairs of scenes ranged from 44 to 94 meters with typical values around 70 meters. Resampling the data for individual scenes onto a common grid for comparison, using the nearest-neighbor approach, indicated that features could be compared to approximately 1 pixel error.

19436 (CONF-7804163—(Vol.2), pp 1471-1480) **Computer classification and delineation of types using Landsat data in two areas of tropical forests in India.** Unni, N.V.M. (National Remote Sensing Agency, Secunderabad, India). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Computer Compatible Tapes of Landsat were analyzed using an interactive computer (M-DAS) and the forest cover types were delineated in two areas, one in the northeastern region and the other in south central region of India. In the first area, broad types like tropical deciduous, tropical semi-evergreen, tropical and temperate evergreen, bamboo, bamboo mixed with other trees, degraded forests, shifting cultivation and regular cultivation were delineated. In the second area only one broad type viz., the deciduous occurs. Here, the classification was done to separate teak type, Hardwickia type (both more than 20 percent), pure bamboo, pure teak (both plantations) bamboo mixed, miscellaneous, and degraded/scrub. Some really scrub areas were misclassified as pure teak and pure bamboo. Since the imagery used was of leaf fall season (15th March 1975) the exposed soils posed problems in discrimination of miscellaneous types in this area. The classified map of both the areas, achieved relatively in very short time, could be of great use for preliminary planning.

19437 (CONF-7804163—(Vol.2), pp 1481-1487) **Analytical positioning of thermal ir imagery for monitoring volcanic activity.** Nasu, M. (Asia Air Survey Co., Ltd., Tokyo, Japan). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

An analytical positioning system of scanner imagery using a Digital Terrain Model (DTM) for relief information was developed for monitoring volcanic activity by thermal observations. The positioning procedure consists of: analytical determination of sensor's exterior orientation parameters; computation of image coordinates for resampling mesh points given by the DTM of the thermal mapping area; and denser resampling of the digital imagery data for the positioning. The fundamental geometric model in the system is the so-called collinearity condition equations for scanner data. At present, film-recorded thermal ir imagery is the original data source, although digitally recorded MSS data can also be processed in this system. The film-recorded thermal imagery was digitized using a microdensitometer and the analytical positioning was applied to the digital data. The developed system was tested using thermal ir data in two stages: study of the accuracy of exterior orientation; and analytical positioning of thermal ir data taken over a currently active volcanic mountain. The test results have shown that the use of the analytical positioning system is quite feasible in thermal mapping of volcanos for the following reasons: terrain is usually rough and steep

and the data covering such area needs relief correction; establishment of ground control points in the mapping area is usually very difficult, and thus two-dimensional distortion correction may not be applicable; the preparation of DTM data is economically feasible since the area of interest is relatively small; monitoring with multitemporal data needs accurate positioning of the data. The practical test has also shown that the residual errors at ground control points after exterior orientation is about 3 to 4 pixels in standard deviation.

19438 (CONF-7804163—(Vol.2), pp 1489-1502) **Processing and analysis of LANDSAT data covering the Baguio Mineral District, Northwest Luzon, Philippines.** Punongbayan, R.S.; Guerrero, D.R.; Lim, J.B.R.; Ramos, E.G.; Sayson, V. (Natural Resources Management Center, Quezon City, Philippines). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The main objective of the study was to determine the usefulness of LANDSAT data in the places with known economic mineral deposits. The test site selected is the Baguio Mineral District in northwestern Luzon. A portion of LANDSAT imagery 1118-01414 covering the Baguio Mineral District was digitally processed and enhanced through the Image 100. Product outputs were used in conducting a lineament analysis of the District. Lineaments in known areas of mineralization which may have acted as possible structural mineralization controls were identified. Other parameters which may have influenced ore localization, like degree of unroofing of the Agno Batholith, and proximity to the intrusive contact were taken into account. The convergence of the above selected favorability factors in other areas within the Baguio Mineral District was then used as basis for selecting specific target areas for exploration.

19439 (CONF-7804163—(Vol.2), pp 1503-1512) **Evaluation of LANDSAT technology for operational use by Nepal resource agencies.** Andrawis, A.S. (South Dakota State Univ., Brookings); Bhattarai, K.D.; Joshi, P.M.; Rajbhandari, M.D.; Vaidya, N.N.; Sherestha, P.P. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Resource scientists from Nepal utilized LANDSAT imageries in studying certain areas of their country with which they were acquainted to investigate the applicability of LANDSAT multispectral scanner data for delineating forest lands, monitoring forest cutting areas, tracing geologic structures and lineaments, and studying drainage patterns and river basins. Results indicate that Landsat data can be successfully utilized for assessing, mapping, and monitoring the natural resources of Nepal, and is a valuable tool for identifying major landslide and erosion areas that threaten the limited agricultural soils of the country.

19440 (CONF-7804163—(Vol.2), pp 1513-1528) **Geological interpretation of LANDSAT-1 imagery of Mindoro Island, Philippines.** Fernandez, J.C.; Montero, P.O.; Teodoro, C.F. (Bureau of Mines, Metro Manila, Philippines). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The geologic features identified in the LANDSAT-1 imagery of Mindoro Island with the use of visual and instrumental methods of interpretation are broad lithologic units, fracture lineaments, and volcanic cones. Lithologies were delineated based on degree of induration which is manifested by texture, pattern elements, and tone. Ultramafic rocks were likewise delineated though they exhibit different characteristics in the image on account of different physiographic conditions. Some of the lineaments seen in the image correspond with known major faults in the area. Among the image anomalies which cannot be identified with any geologic features in the existing geologic map are possibly related to deep-seated structures. However, these unknown features will be correlated with interpreted results from ground geophysical survey. Circular features which also constitute some of the image anomalies were traced in areas where highly indurated rock units occur.

19441 (CONF-7804163—(Vol.3)) **Proceedings of the twelfth international symposium on remote sensing of environment.** (Environmental Research Inst. of Michigan, Ann Arbor (USA). Center for Remote Sensing Information and Analysis; Natural Resources Management Center, Quezon City (Philippines)). 1978. 836p. Dep. NTIS, PC A99/MF A01.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

This is the third of three volumes of the proceedings of the Twelfth International Symposium on Remote Sensing of Environment, held 20 to 26 April 1978 in Manila, Philippines. This symposium is part of a continuing program investigating current activities in the field of remote sensing. The meeting is intended to promote increased international cooperation in research, development and application of this technology, and to stimulate an exchange of information on all aspects of this multidisciplinary field through the presentation of reports on work planned, in progress or completed. Presentations include those concerned with the utilization of this technology in various national and international programs as well as in numerous applications for monitoring and managing the earth's resources and man's global environment. Ground-based, airborne, and spaceborne sensor systems and both manual and machine-assisted data analysis and interpretation are included. All papers included in their entirety were abstracted and indexed for EDB/ERA.

19442 (CONF-7804163—(Vol.3), pp 1563-1572) **Jonglei Canal Protect, Sudan: a LANDSAT imagery approach.** El Shazly, E.M.; Hady, M.A.A.; El Shazly, M.M.; El Ghawaby, M.A.; Salman, A.B.; El Kassas, I.A.; Khawasik, S.M.; El Rakaiby, M.M.; El-Amin, H. (Remote Sensing Center, Cario, Egypt). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

One of the most accepted means of overcoming the water losses at Bahr El Jebel in Southern Sudan, estimated at 12,250 million m^3 annually, is its canalization through a canal some 280 km long connecting Jonglei on Bahr El Jebel with Malakal on the White Nile. This scheme is called the Jonglei Canal Project. The regional mapping and study of the huge Jonglei Canal Project area represent an ideal case for the application of LANDSAT imagery interpretation especially in view of the inaccessibility of most of its coverage, notably in the long rainy season. The implementation of this work was carried out through LANDSAT imagery interpretation in both the dry season and the wet season, together with low reconnaissance flying, ground field work along passable roads and tracks, and extensive laboratory analyses. Maps were accordingly constructed for the geological and environmental units, structural lineations, lineation density, surface drainage, surface water bodies and groundwater potential, soils, land use, vegetation cover, and infrastructure. Thematic extraction maps and computer printouts are prepared on the basis of the previously mentioned maps. In this communication the soils, land use, and vegetation cover of the project area are not given. LANDSAT imagery interpretation has thus provided, within less than eighteen months, including the preparatory period, a regional picture for such a unique area of investigation covering 165,000 km^2 on a scale of 1:500,000.

19443 (CONF-7804163—(Vol.3), pp 1573-1582) **Ring-ditch fortifications in the Rewa Delta, Fiji: archaeology from the air using panchromatic, infrared, and color photography.** Parry, J.T. (McGill Univ., Montreal, Quebec). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Although archaeological research in Fiji has been somewhat limited, the evidence suggests that fortified sites occur throughout the group, with the greatest concentration in the deltas and alluvial flats on the eastern or windward side of the islands. During the nineteenth century, the Rewa delta was one of the most densely populated areas in Fiji, indeed in the whole south Pacific region. Settlements of this period display the characteristic ring-ditch type of fortification, which served as a crude but effective defence against surprise attack. In its simplest form, this consisted of an outer bank and a roughly circular ditch or moat enclosing a fenced habitation area, which was reached by causeways. The air photo analysis commenced with examination of medium scale photography which was available for the greater part of the area. Large scale panchromatic and modified infrared photography was available for only limited areas; however, this was especially useful for a detailed examination of several major site. Color obliques were obtained for most of the major sites, and these proved to be particularly valuable in detecting small details. Provisional scanning of each set of photos with a hand magnifier was followed by stereoscopic examination with an ODSS II. As each ring-ditch site was detected, it was plotted directly onto a 1:50,000 topographic map. Four aspects of the morphology of each site were examined - shape, size of habitation area, number of ditches, number of causeways and their orientation. Size measurements were made with a circle templt, and causeway orientation was recorded using a magnifying comparator. The soil type and site conditions were assessed from the photo tone and texture characteristics. The data for each site was codified using an alphanumeric/symbol classification system as illustrated. Settlement patterns and population density distribution were also analyzed in the aerial photographs. (JGB)

19444 (CONF-7804163—(Vol.3), pp 1583-1595) **Advance in the research and use of remote sensors in natural resources development studies: Chile.** Ortiz, A. (Natural Resources Research Inst., Santiago, Chile). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The Natural Resources Research Institute (IREN) was created in 1964 as a specialized institute that conducted natural resources integrated studies. IREN has based its research on the utilization of remote sensors. In 1973 the use of aerial multiband images was initiated as an analytical way of use to detect some aspects of soils, water and plants in an utmost agricultural region, with highly satisfactory results, so its use was adopted for special agricultural studies. In 1975 IREN established a program of evalua-

tion of the use of LANDSAT images in natural resources integrated studies related to geology, geomorphology, hidrology, soils, and vegetation. It was considered an area in the southern part of Chile where IREN had enough regional information to do this evaluation. Through experience obtained in 1975 a new program was established for the use of LANDSAT images in the survey of natural resources in the northern part of Chile. The purposes of the program were to provide cartographic data at a regional level in geology-mining, geomorphology, soils, climate, and hydrology, to define development feasibility programs at a regional level, and establish satellite images as a normal research tool. The following methology was applied: LANDSAT images analysis, in different wavelength bands and scales; LANDSAT false color images interpretation, through the multiespectral viewer; descriptive legends generated by data obtained from the images; location of field areas as recognition patterns for the different studies; field-checking to evaluate sample sites, descriptive legends and image interpretation; and final cabinet for definitive cartography. The conclusions obtained are reported.

19445 (CONF-7804163—(Vol.3), pp 1609-1615) **Application of LANDSAT and SKYLAB imagery in Mexico: detection of erosion and forest damage.** Rodriguez-Bejarano, D. (Univ. of Michigan, Ann Arbor). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Detection of erosion and forest insect damage was tried out in two regions of Mexico: the central part of the State of Puebla and the northeast region of the State of Guerrero. LANDSAT and SKYLAB imagery were used, together with conventional aerial photography and ground checking. Results showed the possibilities of applying this type of data to extensively affected areas. The examples derived could very well serve to teach natural resources students the limitations and possibilities of visual interpretation of LANDSAT and SKYLAB data in Mexico.

19446 (CONF-7804163—(Vol.3), pp 1617-1642) **Remote sensing inputs into a wetland rice regional production model (Java).** Malingreau, J.P. (Univ., Gadjah Mada, Yogyakarta, Indonesia). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A conceptual model of wetland rice regional production is presented with particular application to the Javanese sawah. Two sub-models are analyzed: a Crop Area sub-Model (CAM) and a Crop Yield sub-Model (CYM). Field observations have shown that a very large spatial and temporal variability in production factors can be found over sometimes small areas. The stratification of the landscape into Homogeneous Production Areas (HPA) is therefore basic to the modeling strategy proposed here. The main crop and environmental parameters (planted variety, water availability, and occurrence of pests) are evaluated over a biological time scale. Remote sensing technology can provide significant inputs at the stratification level as well as at the actual monitoring level, but applications are still limited.

19447 (CONF-7804163—(Vol.3), pp 1643-1651) **Applied research on remote sensing in the field of agriculture.** Haketa, S.; Miyakawa, G.; Michino,T.; Yamamoto, T. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A fundamental research project on the application of remote sensing in the field of agriculture has been performed since 1974. In the case of such a relatively small country as Japan, which has usually small-size crop fields and consequently has many kind of crops in relatively small areas, special problems exist in making accurate crop acreage summations through remote sensing methods. An airborne multi-band camera was selected as the sensor, and ground image processing equipments have been utilized for information extraction. The equipment consists of analog systems such as additive color viewer and multi-color data system, and digital systems such as image digitizing system, data analysis system with interactive color image display coordinated with a small size computer. Multiband camera images were analyzed in 1975 by a densitometer and mini computer. Classification was examined with a simple quadrangular decision rule, and rice, mulberry, navel oranges, etc. were classified with reasonable accuracy. In 1976 multiband camera images were digitized by a specially designed digitizing system, and then ten kinds of crops were classified through a multi-dimensional cell method. Acreage of individual crops were calculated. Accuracy of over 90 percent was obtaned in both classification and acreage summation. The research project is continuing in the 1977 fiscal year, utilizing airborne digital multi-spectral scanner and improved digital image processing techniques.

19448 (CONF-7804163—(Vol.3), pp 1665-1670) **Problems associated with organizing remote sensing applications in a developing country.** Nanayakkara, C. (Survey Dept. of SRI Lanka, Colombo). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The problems involved in organizing an operational remote sensing unit in a developing country are discussed, giving many possible approaches to these problems and suggestions on the different levels of sophistication in technique. The case in SRI Lanka and its approach to the problems are described. Possible solutions are taken up for discussion with suggestions for improvements in technology transfer and training aspects.

19449 (CONF-7804163—(Vol.3), pp 1671-1678) **Experiments in the use of remote sensing from satellite and aerial photography for forest inventory.** Wiroatmodjo, P. (Directorate of Forestry Planning, Bogor, Indonesia). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

One of the objectives of these experiments was to determine the usefulness of satellite imagery for forest inventory. For this purpose some experiments were made on different types of primary forests as well as on plantation forests. Another objective was to develop a basic method for quantitative analyses of forest stand from vertical photographs. The experiments were carried out in the lowland Dipterocarps forest of Kendilo watershed, East Kalimantan. Results indicated that satellite imagery is useful for identification of forested areas, identification of the types of primary forests, rough stratification of forests in flat terrains up to those with gentle hills based on forest stand density, and rough stratification of teak plantation forest in flat up to those with gentle hills based on age class. There is a significant linear correlation between parameters of forest stands of trees with diameters of 20 cm and up (in this context the average number of trees and stand volume per hectare of forested area) and the crown density percentage measured directly from 1:24,000 scale vertical aerial photographs, so that a quantitative analysis of forest stand can be established from aerial photographs.

19450 (CONF-7804163—(Vol.3), pp 1687-1695) **Digital image rectification and enhancement on a minicomputer: analysis of results.** McDonnell, M.J. (Dept. of Scientific and Industrial Research, Lower Hutt, New Zealand). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

New Zealand involvement in the LANDSAT II investigation program has led to the rapid development of a digital image processing facility within the Remote Sensing section of the Physics and Engineering Laboratory of the Department of Scientific and Industrial Research. The recently acquired Optronics C-4300 Colorwrite machine is being used to write processed imagery directly out as a color transparency. The digital image rectification and enhancement techniques developed for use on a minicomputer are described.

19451 (CONF-7804163—(Vol.3), pp 1697-1706) **LANDSAT user needs and administrative responses: density scales, data catalogues, image annotation.** Falconer, A. (Univ. of Queensland, Brisbane, Australia); Gray, D.; Green, A.A. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The present procedure of system interrogation and the consequent response to users which is necessary in order to identify a LANDSAT image, order and receive it can, apparently be simplified by the use of an illustrated image catalog. The illustrated catalog can be rapidly compiled using existing system procedures based on the Canadian ISISFICHE model and using off-set litho printing. The consequent ease of consultation of the catalog and the flexibility in forming weekly, monthly, or annual catalogues alongside the daily catalogue system appear as major advantages. The illustrated catalog provides the user with a ready reference to the position of cloud cover within the scene and the major locational detail is visible also. An improved method of annotating the grey scale on individual bands and thus making color composites easier to analyze is also described. In total a system of receiving stations providing quicklook imagery and a catalogue service backed by a central processing facility creating images as required by user demand, appears to offer an efficient use of regional resources. It may be a useful model for future planning of facilities among nations receiving LANDSAT data.

19452 (CONF-7804163—(Vol.3), pp 1707-1716) **Extraction of soil information from vegetated area.** Fukuhara, M. (Hokkaido National Agricultural Experimental Station, Japan); Hayashi, S.; Yasuda, Y.; Asanuma, I.; Emori, Y.; Iisaka, J. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The mixing or interaction of vegetation signals with soil information decreases the performance of soil identification and mapping. A simple technique to eliminate the vegetation signals from the remotely sensed data and to extract soil information from vegetated area is discussed. The usefulness of the technique is also demonstrated.

19453 (CONF-7804163—(Vol.3), pp 1717-1727) **Land cover studies using LANDSAT MSS digital data: cartographically corrected lineprinter output.** Hardy, J.R. (Univ. of Reading, England). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A suite of programs is described, and methods are suggested for the processing of LANDSAT MSS digital data using a general purpose computer, standard FORTRAN and a standard lineprinter for output. Methods and algorithms for producing cartographically corrected lineprinter output are discussed, enabling the output to be overlaid accurately on a 1/25,000 map to facilitate interpretation and classification. Methods of performing areal computations are given.

19454 (CONF-7804163—(Vol.3), pp 1729-1739) **Evaluation of wavelength groups for discrimination of agricultural cover types.** Kumar, R. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Multispectral scanner data in twelve spectral channels, in the wavelength range 0.46 to 11.7 μm, acquired in July 1971 for three flightlines, were analyzed by applying automatic pattern recognition techniques. These twelve spectral channels were divided into four wavelength groups (W1, W2, W3, and W4), each consisting of three wavelength groups - with respect to their estimated probability of correct classification (P/sub c/) - in discriminating agricultural cover types. The same analysis was also done for the data acquired in August, to investigate the effect of time on these results. The effect of deletion of each of the wavelength groups on P/sub c/, in the subsets of one to nine channels, is given. Values of P/sub c/ for all possible combinations of wavelength groups, in the subsets of one to eleven channels are also given.

19455 (CONF-7804163—(Vol.3), pp 1755-1762) **LANDSAT digital enhancement techniques for mineral exploration in Australia.** Green, A.A.; Huntington, J.F.; Roberts, G.P. (CSIRO Division of Mineral Physics, North Ryde, NSW, Australia). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A LANDSAT image processing system is discussed. The system is based around a mini-computer with image display on an interactive TV system and a film recorder. Software was developed to provide enhancement techniques including contrast modification, ratioing, spatial filtering, stereo pair production and multi-spectral classification. The system was used to produce computer-enhanced images of approximately one-third of Australia in a continuing effort to develop optimum enhancement techniques for each of Australia's major mining areas.

19456 (CONF-7804163—(Vol.3), pp 1763-1768) **Remote sensing and inventory of mineral resources in part of Chandrapur District, Maharashtra, India.** Misra, K.S. (Indian Inst. of Tech., Bombay). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Remote sensing techniques were found to be of immense help in highlighting certain geological features, which have a direct bearing on the inventory of mineral resources in southern part of Chandrapur district of Maharashtra. The area comprises mainly four geological units, vis. Archaean unclassified crystallines, Precambrian metasedimentaries of Pakhal Group and younger sedimentaries belonging to Gondwana Super Group and Deccan Trap basaltic flows. The Archaean crystallines comprise schists, migmatites, granites, pyroxene granulites, quartzites, banded hematite quartzite, basic sills and pegmatite veins. The Pakhal metasedimentaries include quartzitic sandstones, interbedded slates and quartzitic sandstones, siliceous limestone and slates. Gondwanas are represented mainly by shales, sandstones, conglomerates, and limestone. From a structural point of view, the area includes the upper part of main Godavari graben running in NW-SE direction and presents a very complicated and long tectonic history. In all six episodes of deformation due to compressive forces, interspersed with three episodes when tensional forces were active, are discernible in the study area. The faults and lineaments developed during the tectonic deformations were easily picked up on aerial photographs and LANDSAT imageries, and were found to be the sites of hydrothermal mineralization in various parts of the area. The Thanevasana base metal mineralization as well as barite mineralization near Kopela village are situated on the fault planes running in NW-SE direction. A number of associated sister faults are the subject of intensive study for the inventory of mineral deposits.

19457 (CONF-7804163—(Vol.3), pp 1769-1777) **Analysis of multi-date LANDSAT data.** Chandrasekhar, S.; Maruthachalam, M. (National Remote Sensing Agency, Secunderabad, India). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Detection of surface change phenomenon is one of the important applications of remote sensing. For this study LANDSAT data in the form of Computer Compatible Tapes (CCTs) provided the basic input, and it was supplemented by imageries. Each scene covers a ground area of approximately 185 km x 185 kms and contains 3240 picture elements and 2340 scan lines. Each picture element contains the energy reflected from ground surface of 57 m x 79 m, and this energy is recorded in four spectral bands. For temporal study, multi-date data pertaning to the area under study are selected. For this analysis two areas (one in Punjab and another in Andhra Pradesh in India) were considered. For these areas, multidate data tapes were available and also imageries. One important aspect to be considered in multidate analysis is the registration of the image pertaining to different dates. There are different registration techniques and depending upon the size of the area each technique will be best suited. Two techniques were used for registration and these are explained in future paragraphs. For classification of data, a supervised technique using the maximum likelihood decision rule assuming Gaussian distribution of data was adopted. For multidate data the dimension of the measurement vector becomes large, and the technique of the principal component transformation is used to reduce the dimension of measurement space but still retaining the maximum information content. The details of the technique of analysis and a discussion of results are presented.

19458 (CONF-7804163—(Vol.3), pp 1799-1807) **LANDSAT interpretation for development studies.** Trevett, J.W. (Hunting Technical Services Ltd., Borehamwood, England). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Experience in conventional mapping, geological and geophysical prospecting, and land and water resources consultancy are outlined. The majority of projects that are undertaken are for development studies or in developing countries. Projects in the Sudan, Ethiopia, Iran, Thailand, and Nigeria are reviewed. Since its introduction LANDSAT has found a firm place in the data sources used by the companies, hardly a project is now undertaken that does not use the imagery in some way and some of the projects are wholly based upon the use of various forms of remote sensing. The methods used are a practical application of LANDSAT for conventional use and show how, without recourse to computer based technology, the imagery can still provide invaluable information. As a conclusion some comments are made about more advanced technology and its application to development studies.

19459 (CONF-7804163—(Vol.3), pp 1809-1825) **Ten-ecosystem study: LANDSAT ADP mapping of forest and rangeland in the United States.** Kan, E.P. (Lockheed Electronics Co., Inc., Houston, TX); Weber, F.P. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The Ten-Ecosystem Study was designed to assess the maximum information content of LANDSAT data and its utility for large area classification using a uniform technical approach on the 10 generalized forest and rangeland ecosystems of the United States. Conclusions on the feasibility of using LANDSAT remote sensing automatic data processing methods, selecting the best seasons, analyzing costs and the effects of site complexity, miscellaneous analysis, problems, and recommendations were derived from 2 years of study, the project being three-fourths completed.

19460 (CONF-7804163—(Vol.3), pp 1849-1857) **Determination of wheat acreages from LANDSAT imagery in the Narrabri District of New South Wales, Australia.** Parsons, A.J.; Fitzpatrick, E.A. (Univ. of New South Wales, Sydney, Australia). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

For the 1975 wheat-growing season all LANDSAT-2 imagery obtained between May (the time of sowing) and November (the time of harvesting) was analyzed for three study areas in the Narrabri district of New South Wales, Australia with the object of determining optimum times for identifying areas planted to wheat, the spatial varability in the identifiability of areas planted to wheat, and the value of using sequential imagery for correcting errors of misclassification. It was found that best results are obtained in early June, corresponding to the period immediately after sowing when all areas planted to wheat appear as bare ground, and in late September, when the crop is in head but not begun to ripen. Considerable spatial variability in the accuracy of determination of areas planted to wheat is obtained. By using in conjunction the imagery for two dates upon which acceptable results are obtained, errors of misclassification can be reduced. Results of this study indicate that for operational use of LANDSAT data for wheat-area mapping in the New South Wales wheat belt the total survey area must first be stratified into smaller areas in which crop phenology, terrain type, and soil type are uniform. The study also shows that repeated analysis of imagery obtained at optimum times during the growing season may help to eliminate most Type II errors of misclassification.

19461 (CONF-7804163—(Vol.3), pp 1859-1869) **Study on computer analysis of land use classification of Metro Manila.** Pascual, A.;

Silonga, W. (Natural Resources Management Center, Quezon City, Philippines). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Digital analyses utilizing the Interactive Multispectral Image Analyzer System were undertaken to classify the existing land use patterns within Metro Manila. Using CCT data three subscenes at scale 1:100,000 projected on the CRT (TV screen) were extracted from LANDSAT I Scene No. 1153-0146300 and LANDSAT II Scene No. 2455-012945, dated December 23, 1972 and April 21, 1976, respectively. These subscenes were processed utilizing digital techniques and various computer programs incorporated in the Interactive Multispectral Image Analyzer System in order to come up with a more refined land use classification. Comparisons were made between the 1972 and 1976 subscenes and changes were noted down. To show the accuracy and reliability of the data obtained from the LANDSAT imagery, the 1976 LANDSAT statistical data gathered from the Analyzer were correlated with existing data gathered by the Metro Manila Commission in 1976, which utilized conventional ground survey methods. Preliminary comparative evaluation of the data obtained with the existing source data maps indicated the extensive changes and growth that transpired in the area during the period 1972 to 1976. The results of the evaluation of broad land use categories derived from satellite data could be useful to conceptual studies in land form changes and environmental development planning.

19462 (CONF-7804163—(Vol.3), pp 1871-1882) **Mapping tropical vegetation zones in the State of Veracruz, Mexico.** Soto, M.; Lozano, F.; Mejia, C.; Diez, J.A.; Medina, M. (Universidad Nacional Autonoma de Mexico, Mexico City). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A detailed study of tropical vegetation zones using numerical analysis of Landsat data is presented. The study area is totally within the state of Veracruz, Mexico, and reaches from the Cofre de Perote mountain to the town of Actopan. It is a complex ecological mosaic controlled by diverse factors such as altitude (from 250 to 4200 m), varied relief, position with respect to winds, etc. These factors, combined with intensive human activity, produce a great variety of vegetation communities, including high pastures, pine forests, low deciduous forests, coffee plantations, sugar cane plantations, orchards, and others. Analyses were based on a single image from 1973, and were made with SIADIS, the System for Automatic interpretation of Satellite Images of the Remote Sensing Department of the Commission of the National Hydraulic Plan of Mexico. Results consist of a detailed vegetation map of the study area, and demonstrate the usefulness of LANDSAT for Vegetation mapping of tropical areas.

19463 (CONF-7804163—(Vol.3), pp 1883-1893) **Interpretation of Northern Thailand swiddening and multiple cropping systems using multidate LANDSAT images and computer compatible tapes.** Bruneau, M. (Centre d'Etudes de Geographie Tropicale, Bordeaux, France); Le Toan, T. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A photo-interpretation analysis of uplands west of Chiang Mai, Northern Thailand, at three different dates (band 7) during the dry season shows the progresson of fires (burnt areas). The overall features of the area (uplands and lowlands) is given by interpreting the 27th January 1973 and 8th April 1975 color composite images. Classification of CCT tapes of a part of uplands and lowlands, using supervised methods, gives forest types, swidden area, savanna, paddy fields in the highlands east of Doi Inthanon, and changes of irrigated agriculture between January and March in the alluvial plain.

19464 (CONF-7804163—(Vol.3), pp 1895-1908) **Use of large scale aerial photographs for ecological studies in a grazed arid ecosystem.** Hacker, R.B. (Dept. of Agricultural, South Perth, Western Australia). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Color aerial photographs at a scale of approximately 1:250 were used to obtain plant inventories for six study sites in a multilayered arid zone community. Species were divided into size classes based on canopy area. Coordinates for each individual, read from the photographs, were transformed to ground coordinates and used to produce plant counts in contiguous quadrats. Multiple pattern analysis of these data revealed the major features of community variation and their corresponding scales of pattern. Within-site variation in grazing pressure was the major factor influencing community pattern in three sites. Responses of the major species to grazing were clearly defined. Aggregation of shrubs around the relics of older populations of trees or large shrubs, or under the canopies of living individuals, primarily determined (or at least influenced) vegetation pattern on the remaining sites. The presence of these relics is thought to impose a weak fundamental pattern on this community.

19465 (CONF-7804163—(Vol.3), pp 1909-1915) **Some notes on the experiences of LAPAN (The Indonesian National Institute of Aeronautics and Space) in the development of remote sensing in Indonesia.** Irsyam, M. (Indonesian National Inst. of Aeronautics and Space, Jakarta, Indonesia). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

LAPAN began development of indigenous capabilities in remote sensing in 1972. Within the frame of these activities, a number of visible and infra-red sensors, processing and interpretation equipment are available at present. A number of experiments have been carried out using said instruments. Those experiments and experiences and problems faced by LAPAN during the conduct of remote sensing activities are reviewed.

19466 (CONF-7804163—(Vol.3), pp 1919-1935) **Vegetation mapping of Nigeria from radar.** Trevett, J.W. (Hunting Technical Services Limited, Borehamwood, England). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

In 1976, the Federal Government of Nigeria awarded contracts for acquiring radar imagery cover for all Nigeria, and interpreting the imagery for a vegetation survey. The imagery acquisition scale was 1:250,000 with a swath width of 25 km using an X band real aperture system. The imagery is taken in two directions so that there is complete cover with both a north and a south looking direction. The contract requires that maps be produced at 1:250,000 scale based upon the JOG series to show the vegetation associations and that selected forest reserves be mapped in detail at 1:100,000 and 1:50,000 scale also based upon the radar imagery. Further the consultants were required to train Nigerian staff in the use of radar imagery and to carry out a special research into the use of digital analysis techniques to radar imagery. The project is due for completion in October 1978; the progress on the mapping and the digital analysis to date is described.

19467 (CONF-7804163—(Vol.3), pp 1947-1955) **Japan's receiving and processing facilities for LANDSAT data.** Haruyama, Y.; Yamamoto, Y. (National Space Development Agency of Japan, Tokyo). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Japan's receiving and processing facilities for LANDSAT data are now under construction, aiming to be completed by the end of 1978. The facilities are located in the middle part of Saitama Prefecture (36°00'N, 139°21'E), about 50 Km northwest of Tokyo, and consist of four systems; receiving, recording, data processing, and photographic processing systems. The facilities will be able to correct radiometric and geometric distortions existing in incoming LANDSAT image and then will be able to produce computer compatible tapes, films, and papers. These output products will be available by adjacent countries with reasonable prices for international cooperation. The system construction, the processing method, and output products of the facilities are reported.

19468 (CONF-7804163—(Vol.3), pp 1957-1971) **Application of texture analysis and image enhancement techniques for remote sensing.** Iisaka, J. (Tokyo Scientific Center, Japan); Nakata, E.; Imanaka, M.; Ishii, Y.; Miyazaki, Y. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A discussion is presented of two processing types, image enhancement and pattern recognition - especially that based upon textural feature. Texture analysis was applied to aircraft MSS data of Otoineppu, in the northern part of Hokkaido to classify local forest zone by textural feature. Compared with spectral analysis, this method proved to be more useful and efficient. In applying image enhancement techniques, the Middle Area of Japan was selected as the test site where one of the famous Japan's macrostructures, Fossa Magna, exists. An attempt was made to obtain large linear feature and also piecewise linear approximations to lineaments or segments of linearments usng the above-mentioned filters and differential filters.

19469 (CONF-7804163—(Vol.3), pp 1973-1983) **Economic way of data handling and reproduction of LANDSAT d..ta.** Vibulsresth, S. (National Research Council, Bangkok, Thailand); Booncong, V.; Morgan, J.O. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

An economic way of data handling and reproduction of the LANDSAT data was designed and implemented. Effective low cost procedures which are appropriate for use in other developing countries are presented. The discussion is centered around the reproduction of black and white imagery at 1:1 million, 1:500,000 and 1:250,000 scale and the diazochrome color composite transparencies at 1:1 million scale. The system enables Thailand to provide all the required data at the quality and quantity needed by user agencies and can be expanded to meet the regional requirements.

19470 (CONF-7804163—(Vol.3), pp 1985-1992) **LANDSAT-digital data as a tool in quaternary geological mapping in the coastal plain of the Malaysian Peninsula.** Prelat, A.E. (Stanford Univ., CA); Lyon, R.J.P.; Van de Meene, E.A. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The Geological Survey of Malaysia has begun a systematic mapping of the coastal plain of the Malaysian Peninsula. The present research was conducted to evaluate the use of LANDSAT digital data to assist the geologist in quaternary mapping. The study was carried out at the Stanford Remote Sensing Laboratory during a 10-day period with the assistance of a geologist with recent field experience in this area of Malaysia. The Remote Sensing Interactive System (STANSORT) was used to view selected channels and ratios on the 3-color Grinnell TV display, make simulated-grey level pictures (Dotprints) on a Printronix matrix printer, and scene classification. The supervised classification technique, known as Discriminant Analysis, was applied based on the knowledge of the geology. A number of soil units were selected from the geological map to define training groups, and then the rest of the study area was classified into the pre-selected categories. The results indicated that the LANDSAT information in combination with geological knowledge improved the interpretation and quality of maps with appreciable time savings.

19471 (CONF-7804163—(Vol.3), pp 2011-2018) **Resources engineering investigations: an approach and output applicable to Chandrapur Project.** Parthasarathy, A. (Centre of Studies in Resource Engineering, Bombay, India). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The basic concepts, methodology and the interpretative means specially relevant to the various disciplines are to be used in exploration, assessment, and utilization of natural resources. Chandrapur Project presently described is a multidisciplinary project. The project pertains to the study of natural resources in an area of nearly 6000 sq. kms in parts of Chandrapur District, Maharashtra State, India. The region is largely covered by forests and is endowed with mineral resources not fully explored and utilized. Ground and surface water potential of the region are to be fully assessed, and the region is to be put to optimal landuse development for the fuller economic growth of the area. The project involves use of satellite images and aerial photographs followed by ground check, geological, hydrologic, geotechnical, and pedological investigations. With the help of the maps prepared from field and laboratory data relevant to this integratred approach pertaining to resource engineering studies and the results obtained, the work in progress is briefly presented.

19472 (CONF-7804163—(Vol.3), pp 2045-2049) **Thailand's littoral mudflats as interpreted from LANDSAT imagery.** Sriplung, N. (Applied Scientific Research Corporation of Thailand, Bangkok). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

An investigation was conducted to determine the littoral and sublittoral mudflats of Thailand based on LANDSAT imagery. The interpreted map was verified by ground truth survey using cars, boats, and helicopter. A combination scheme of diazochrome color composite transparencies was conceived which yields best results for mudflat identification. The study showed an area of 910 km^2 and 3700 km^2 Thailand's littoral and sublittoral mudflats respectively.

19473 (CONF-7804163—(Vol.3), pp 2051-2070) **Coral reef mapping using LANDSAT data: follow-up studies.** Bina, R.T. (Natural Resources Management Center, Quezon City, Philippines); Carpenter, K.; Zacher, W.; Jara, R.; Lim, J.B. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Additional techniques for mapping and interpretation of coral reef imageries based on the digital processing of LANDSAT data using the Image 100 Multispectral Analysis System are reported. Major physiographic zones and bottom cover types of Apo Reef (Mindoro Island, Philippines) were categorized and mapped using combinations of unsupervised and supervised modes of digital processing. Categories were checked by actual ground survey. The advantages and limitations of LANDSAT 1 and 2 data for inventory and monitoring of coral reefs are discussed.

19474 (CONF-7804163—(Vol.3), pp 2081-2090) **Application of remote sensing techniques to forest vegetation surveys in tropical areas and urban fringe land use problems in Costa Rica.** Cannon, T.K. (Resources Development Associates, Los Altos, CA); Ellefsen, R.A.; Craib, K.B.; Crespo, J. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The capability of various remote sensing techniques was evaluated for the determination of forest land cover and urban expansion within the nation of Costa Rica. The relative effectiveness, various scales and types of aerial photography, and LANDSAT satellite data were compared and evaluated. Conclusions were that aerial photography must be relied on for management data base compilation whereas LANDSAT data can provide immediate national data and can provide a monitoring base.

19475 (CONF-7804163—(Vol.3), pp 2091-2100) **Automatic classification of reforested Pinus spp. and Eucalyptus spp. in Mogi-Guacu, S.P., Brazil usng LANDSAT data.** Shimabukuro, Y.E.; Hernandez, P.F.; Koffler, N.F.; Chen, S.C. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Single date LANDSAT CCTs were processed, by Image-100 to classify Pinus and Eucalyptus species and their age groups. The study area Mogi-Guacu is locted in the humid sub-tropical climate zone of Sao Paulo State. Prominent Pinus species are P. elliottii and P. taeda. Eucalyptus species are E. alba and E. saligna. The ages of these tree types range from 8 months to 20 years. The study area was divided into ten preliminary classes and feature selection algorithm was used to calculate Bhattacharyya distance (B-distance) between all possible pairs of these classes in the four available channels. The classes having B-distance values less than 1.30 were grouped together resulting in four classes: class PE - P. elliottii; class PO - Pinus species other than P. elliottii; class EY - Eucalyptus spp. under two years; and class EO - Eucalyptus spp. more than two years. For classification, sngle cell signature acquisition option was used. The low percentages of correct classification for class PO was due to its relatively small area (a total of 1.44 km^2) while for class EO error was caused by the similar signature responses of cerrado, gallery forest and heterogenous P. elliottii plots in the study area. The percentages of correct classification ranged from 70.9% to 94.12%. Comparisons of acreage estimated from the Image-100 with ground truth data showed agreement. The Image-100 percent recognition values for the above four classes were 91.62%, 87.80%, 89.89%, and 103.30%. Greater precision of area estimation could have been obtained if the ground truth data based on the seedling area at planting time had been up-dated.

19476 (CONF-7804163—(Vol.3), pp 2101-2108) **Thermal infrared remote sensing of soil moisture: what can be expected from HCMM data?.** Bonn, F.J. (Universite de Sherbrooke, Quebec). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The Heat Capacity Mapping Mission (HCMM) Satellite, to be launched by NASA in April 1978 will map thermal patterns of the earth's surface, especially thermal inertia. Thermal inertia of soils is related to soil moisture content, and this gives HCMM the potential of mapping soil moisture. However, certain restrictions exist, especially in vegetated area, as shown by the experiments made in Sherbrooke, in comparing remotely sensed and ground truth data.

19477 (CONF-7804163—(Vol.3), pp 2109-2120) **Grassland and forestry applications from New Zealand LANDSAT data.** Cochrane, G.R. (Univ. of Auckland, New Zealand). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Maintenance of plant cover in catchment areas of this predominantly hilly to mountainous land of New Zealand is vital for water regulation and protection of productive lowlands. Any techniques that can contribute towards better monitoring or management of New Zealand's grasslands and forests is of vital importance both to New Zealand, as a producer, and also to a fibre and food-hungry world with a rapidly increasing population and decreasing resources. A sampling model that has proved useful involves three stages of analysis: LANDSAT data at small scales (1:1,000,000) for broad large area survey; substage aircraft photography of selected representative sample areas at intermediate scales (1:15,000); and, field survey at sample sites within the former for the most detailed studies to calibrate spectral reflectances with forest or pasture composition, productivity, vigor, incidence of disease or othe physiological stress factors, role of management, influences of fertilizers and soil conditions, felling, logging, and silvicultural practices, or other relevant aspects. In addition, a range of analytical techniques - photographic, optical, electronic, and digital methods - can be applied to LANDSAT data for deriving a range of information in applied problems of forestry survey and management and for rapid or repetitive assessment of pastures at different scales. Examples of each of the four analytical methods are given. An analysis of the relative cost and usefulness of each of these four methods, related to the degree of technological development available to potential users, has relevance to others than in the specific New Zealand context. Inferences are made concerning possible contributions to data analysis that may be expected from LANDSAT-III thermal band and the higher resolution panchromatic photographic imagery from the satellite.

19478 (CONF-7804163—(Vol.3), pp 2131-2140) **Automatic collection of environmental ground truth data in Chile by employing earth orbiting satellites.** ArayaF, M. (Univ. of Chile, Santiago). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The main aspects of Chilean experiences to collect environmental ground truth data from remote sites, by employing Satellite Data Collection Systems (DCS) are described. This technology employs several automatic sensing stations called Data Collection Platforms (DCPs); the DCPs send the data obtaned by the sensors connected to them to the space, where a satellite relays the information to a ground receiving station for the final distribution of the data to the users. The results obtained in the Chilean DCS Exerimental Plan have been very successful and it looks very possible the operational employment of Satellite DCS in Chile, in the next future. The main theoretical and practical aspects of Satellite DCS are presented in the first part of this paper. The second part is related with Chilean DCS Program. Finally, the conclusions and Bibliography are included.

19479 (CONF-7804163—(Vol.3), pp 2141-2150) **Design of decision-tree classifier for remote sensing applications.** Chen, Z.; Tseng, L.Y. (National Chiao Tung Univ., Hsinchu, Taiwan). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

In remote sensing data processing, the classification rules for identifying land cover types are mainly evaluated by two performance factors: the amount of computation time used and the correct recognition rate achieved. A decision-tree classifier is considered in the present paper. The decision tree is formally shown to be embedded in an AND/OR tree that represents all possible classification outcomes. These outcomes are obtained with respect to all feature sets generated by a moderate number of pattern features. A search process in terms of forward and backward procedures is developed to generate the tree. A cost function based on the two performance factors is used to order nodes for expansion. Various types of pointers and tables are set up to link and to store all relevant tree structure data. An alpha-beta procedure is stated to make the search more efficient. Experimental results are included and discussed.

19480 (CONF-7804163—(Vol.3), pp 2151-2162) **Land use map compilation system from aerial MSS data.** Tanaka, S. (Remote Sensing Tech. Center of Japan, Tokyo). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A method of practical land use map compilation system from aerial MSS data is described. As compared with satellite data, aerial MSS data has greater distortion geometrically and radiometrically, and is more complicated. It is not easy to eliminate completely these two distortions. But by extracting the main factors which cause great distortion and correcting these, it is possible to change original imagery into near ideal imagery status. The factor, which causes great distortion and one of the methods of correcting it, is discussed. To discriminate the state of land use from multispectral scanning (MSS) data, maximum likelihood method is considered to be one of the most proper one. According to experience, the istrument of a maximum likelihood method names MCP developed by Bendix Co., Ltd. is considered to be sufficient. A knowledge of the correction method applicable to only one scene is not enough for compilation of land use map in practice. A method of mosaic of aerial MSS data is necessary to be devised. Extending the method of aerial photo mosaic, a method of the aerial MSS data mosaic is set up. The combination of three techniques, maximum likelihood method, correction of MSS data distortion, and method of MSS data mosaic can lead to a practical land use compilation system from aerial MSS data. As a result of the system, a land use map of western Tokyo area made up of 80 TV imagery photographs was devised and is included.

19481 (CONF-7804163—(Vol.3), pp 2163-2176) **Production of 1:250,000 maps of precision rectified and registered LANDSAT imagery using the MDA image analysis system: initial results.** Orth, R.; Wong, F.; MacDonald, J.S. (MacDonald, Dettwiler & Associates, Richmond, British Columbia). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A description is given of the use of the Image Analysis System (IAS) for the production of precision rectified and registered LANDSAT imagery. The introduction is followed by a description of the IAS and its capabilities for general digital image analysis. The use of the system for the production of rectified and registered LANDSAT images is then described, together with an assessment of image accuracy. The final section summarizes this use of the IAS in providing image products and data for application in small scale mapping and resource analysis.

19482 (CONF-7804163—(Vol.3), pp 2177-2191) **LANDSAT and photographic remote sensing for arid land applications in Australia.** Tueller, P.T. (Univ. of Nevada, Reno); Honey, F.R.; Tapley, I.J. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Theme extraction (supervised classification) on data from LANDSAT computer compatible tapes has proven valuable for arid land application in Australia. Suitable themes are established using an unsupervised parallelepiped technique. Mapping can be accomplished with this algorithm at considerable savings in computer costs. Understanding and interpretation of the LANDSAT 4-band signatures allows for vegetation mapping and other uses throughout a given LANDSAT scene. Color aerial photographs provide suitable data for interpretation and verification.

19483 (CONF-7804163—(Vol.3), pp 2193-2198) **System for the coherent processing of remote sensing imagery.** Lummaux, J.C.; Braconne, S. (Institut Geographique National, Paris, France). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

An image processing system is described which, starting with digital remote sensing data, produces either a thematic interpretation or a general map product. Specific results are described concerning forest fires studies, town planning, revision elements for topographic maps in France and Africa. Finally the advantages are shown of using an interactive image processing system such as the 101 system at the Institut Geographique National particularly the fundamental role played by the display console.

19484 (CONF-7804163—(Vol.3), pp 2199-2204) **Varied applications of satellite remote sensing practiced by the Federal Institute of Geosciences and Natural Resources of the Federal Republic of Germany.** Muehlfeld, R. (Federal Inst. of Geosciences and Natural Resources, Hannover, Germany). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Studies on mineral, fuel, and groundwater exploration, as well as investigations into the quality and distribution of soils and improvement of their use for sustained production in agriculture and forestry are outlined briefly. Many activities are connected with technical aid projects in developing countries. Satellite remote sensing (mostly as LANDSAT images and to some extent also LANDSAT digital date) was applied to a considerable variety of projects. The most simple but effective use of LANDSAT images was as a topographical basis for a geological and geochemical study of a 120,000 km^2 area in the Sudan. Linear structures were investigated in several different regions. An investigation of a large region on the Canadian Shield showed some results despite the adverse natural conditions (thick glacial till, heavy forest cover). In the Sahel Zone of Niger and Upper Volta LANDSAT images were evaluated for a variety of closely related purposes, including preparation of a geologic map, location of groundwater reservoirs, and preparation of a combined soil and land capability map. In addition, observations were made on population density, distribution of agricultural activities, and damage to the natural environment. The LANDSAT study of a sedimentary basin in Eastern Asia was used to follow sedimentary rocks over long distances even under a cover of tropical forests. In an area of the Argentine Pampa the distribution of salinity in the near surface groundwater was investigated with chemical analysis of many groundwater wells and with geoelectric measurements. By comparison with LANDSAT and SKYLAB images a correlation was established between the vigour of the vegetation and the salinity of the near surface groundwater. (JGB)

19485 (CONF-7804163—(Vol.3), pp 2205-2216) **Increased visibility from the invisible: a comparison of radar and LANDSAT in tropical environments.** Gelnett, R.H. (Motorola Aerial Remote Sensing, Inc., Phoenix, AZ); Dellwig, L.F.; Bare, J.E. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The unique capability of side looking airborne radar in recording terrain data essentially regardless of daylight or weather conditions has been sufficient justification for its utilization in cloud shrouded areas throughout the world, particularly when there is a critical time factor or a need for specific seasonal coverage. In geologic exploration, RADAR imagery has often been considered for utilization only if LANDSAT imagery or aerial photographs are not available. However, imaging in a segment of the electromagnetic spectrum other than the visible and near infrared portions should be expected to provide information supplemental to other kinds of imagery. A comparison of LANDSAT and RADAR images in several areas substantiates this expectation. Because RADAR senses microrelief or surface configuration and dielectric properties of vegetation rather than degree of vigor as in near infrared imagery, any initial classification is supplemented and a level of discrimination not otherwise obtainable is realized. Linear and curvilinear geologic elements identifiable on both LANDSAT and RADAR imagery can be more precisely defined on RADAR imagery. Furthermore, even some major linear features may be well defined on RADAR imagery although not identifiable on LANDSAT imagery. Definition is largely a function of finer resolution and to some lesser degree shadowing. Drainage networks may be more accuratey located on RADAR imagery and networks may be expanded to include lower order streams than those identifiable on the LANDSAT image. Such

improvement is primarily due to contrasts in the canopy configuration or microrelief of the vegetation.

19486 (CONF-7804163—(Vol.3), pp 2217-2225) **Remote sensing application for geological mapping of Pahangan Street, Central Kalimantan, Indonesia.** Soejitno, T. (Geological Survey of Indonesia, Bandung). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

To investigate the geology of the area, several studies were carried out, i.e. the LANDSAT study, the airphoto and aeromagnetic studies, ground survey and compilation. In studying the LANDSAT, two methods were carried out, the pattern and the spectral analyses. Besides using these methods to complete the geologic map of the area, they also indicate some potential areas of mineralization.

19487 (CONF-7804163—(Vol.3), pp 2227-2244) **Geomorphology and natural resources of the COIPASA area using LANDSAT imagery.** Suarez M, M. (Geological Survey of Bolivia, La Paz). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Studies indicate that LANDSAT imagery is an excellent tool to analyze and evaluate natural resources, and that geomorphology is the most appropriate science to investigate natural resources for the development of a particular area. The study area is located in the Department of Oruro (Bolivia) covered by a LANDSAT image named COIPASA. The area under study is dominated by a semiarid climate where different processes such as Volcanic, Eolian, Fluvial, and Lacustrin processes have shaped the landscape. Sparse vegetation all over the area is dominated by shrub and grass such as Thola (Lepidophyllum quadrangulare) growing mainly in sandy soils with a high water table. It seems that the surroundings of Sajama Payachata and Guallatiri volcanoes are the most profitable areas from the hydrological and land use point of view for agricultural purposes. Perennial snow covering the before mentioned volcanoes originate many fresh-water streams. Vegetation, mainly Thola has increased. Livestock of Llama (Lama Glama) and Alpaca (Lama Pacos) is widespread where water is concentrated in swamp areas (Paramos). Material coming from the highest part of the volcanoes, chiefly by denudational processes (sheet erosion) and gravity is deposited at the foot of such volcanoes, forming thick deposits of soils that are excellent for agricultural use. The southern part of the area presents a completely different morphological condition. The Lauca River drainage basin is to a great extent covered by sand dune and flooded areas. These flooded areas become in many cases, depressions characterized by salty soils where only paja brava grows. No crops are found in these areas because of the high degree of salinity and aridity. The Lauca River forms a delta plain in the neighborhood of Salar de Coipasa, causing serious damage to the Chipaya village.

19488 (CONF-7804163—(Vol.3), pp 2267-2276) **Tell-us: a combined surface temperature, soil moisture, and evaporation mapping approach.** Rosema, A. (Environmental Analysis and Remote Sensing, Delft, Netherlands); Bijleveld, J.H.; Reiniger, P.; Tassone, G.; Blyth, K.; Gurney, R.J. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

In the framework of the Tellus Project of the European Communities, an algorithm was worked out permitting the evaluation of the thermal inertia and of the surface relative humidity of bare and scarcely vegetated soils from remotely sensed day and night surface temperatures. The cumulative daily evaporation can also be calculated by this method. The algorithm was tested on existing data from a field experiment and was applied in a flight experiment. While the calculated soil moisture agreed satisfactorily with the average moisture content of the top soil layer, the estimated daily evaporation deviated from the measured values due to simplifications inherent in the model.

19489 (CONF-7804163—(Vol.3), pp 2277-2283) **Sedimentation pattern and land formation studies in the Feni and Little Feni River estuaries using LANDSAT imageries.** Pramanik, M.A.H.; Chaudhury, M.U.; MacLeod, N.H. (Bangladesh LANDSAT Programme, Dacca). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

This study of land formation in tidal estuaries of the Bay of Bengal was undertaken to make a preliminary estimate of the effects of installing flow regulators in tidal rivers. In 1967, a flow regulator was placed in the little Feni river to provide water for winter irrigation in southeastern Bangladesh south of Comilla and east of Noakhali, near the town of Feni. Each winter the river channel on the seaward side of the regulator has been silted to the extent that excavation is required to re-establish new flow in the spring. The sedimentation process which led to land formation in the coastal areas has, as in the case of Little Feni River, also led to partial closing of the Feni estuary. Analysis of LANDSAT data of the Little Feni estuary at the Bangladesh LANDSAT Centre for the years 1973 to 1977, indicated that in addition to te closing of the main channel by sedimentation, sixty percent of the open water area in the estuary in 1973 is now permanent land, formed by sediments from the Bay. In the adjacent, much larger Feni River estuary, there is no regulator at the present time. There is, however, a programme for installation of a regulator very soon. Analysis of LANDSAT data of the Feni River estuary indicates that land that has been formed occupies forty percent of the 1973 open water surface. From these studies it is clear that the present sedimentation in the Feni and Little Feni estuaries is closing off the river flow to the seas, whether or not a regulator is present. It is likely that a regulator placed near the mouth of such deltaic rivers may accelerate the silting up process in the Bay of Bengal.

19490 (CONF-7804163—(Vol.3), pp 2297-2306) **Land use inventory of north Thailand using LANDSAT imagery.** Omakupt, M. (Dept. of Land Development, Bangkok, Thailand). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The need for an accurate and up-to-date land use information by an airborne or satellite sensor is especially significant when repetitive surveys are required. Remote sensing technique now provides a hitherto unavailable capability for detecting and mapping land use features and monitoring dynamic events of an area, in a repetitive and temporal basis. Land use inventory in Thailand has been undertaken by the Department of Land Development, Ministry of Agriculture and Cooperatives as an important application program of remote sensing from satellites. The program is first being focused upon mapping and determination of the major types of land use in north Thailand. The results are discussed.

19491 (CONF-7804163—(Vol.3), pp 2315-2321) **Remote sensing application to wildlife management in the US Fish and Wildlife Service.** Marmelstein, A.D. (Fish and Wildlife Service, Washington, DC). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Remote sensing as a tool in wildlife management can be applied to various aspects of this discipline at the regional/national/international perspective. In the US Fish and Wildlife Service (FWS), aerial and orbital imagery are being utilized in both research and operational modes to address data requirements generated by environmental impact assessment, baseline ecological analysis, and wildlife resource management. As an example of remote sensing applications in each of these categories, relevant features of the National Wetland Inventory, ecological analysis of the lands under energy related development in the northern Great Plains, and assessment of nesting success of Arctic breeding geese are discussed.

19492 (CONF-7804163—(Vol.3), pp 2323-2332) **Experiment to evolve methods for separation and identification of agricultural crops from multispectral information.** Ayyangar, R.S. (National Remote Sensing Agency, Secunderabad, India). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Spectral separation and identification of crop species and their growth stages was studied under Indian agricultural system from the multispectral data of airborne multispectral scanner with the aid of highly interactive computer system. The results indicated that by careful consideration of multispectral responses of the crops with respect to variation in growth, it is possible to identify crop species and their growth stages. Attempts were made to select the best channel combination of the eleven band information to obtain maximum separation and accurate identification of crops using computer analysis.

19493 (CONF-7804163—(Vol.3), pp 2333-2342) **Determination of spectral signatures of vegetated surfaces by radiometric ground measurements.** Fischer, W. (Fraunhofer-Gesellschaft Heidenhofstr., Freiburg, Germany). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Spectroradiometric measurements with narrow bandwidth were made in the wavelength range from 400 to 1100 nm. The dependence of the spectral reflectance factor R(lambda) on solar and observational zenith and azimuth angles for young and ripe wheat, vine, spruce, and feeding turnips was investigated. As a result it was found, that the shape of the R(lambda)-curve of young wheat in contrast to ripe wheat depends strongly on the measuring geometry.

19494 (CONF-7804163—(Vol.3), pp 2343-2349) **Mangrove inventory of the Philippines using the Landsat multispectral data and the image 100 system.** Bina, R.T.; Jara, R.; de Jusus, B. Jr.; Lorenzo, E. (Natural Resources Management Center, Quezon City, Philippines). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

To determine the potentials of LANDSAT multispectral data in the inventory of Philippine mangrove forests, an investigation was conducted employing computerized processing techniques using the

Image 100 interactive multispectral analysis system. The study applied two basic procedures, namely, the spectral signature acquisition method and the digital classification program. For ground truth, information came principally from ocular inspection of selected study sties. Preliminary results of the investigation yielded indications of the potentials of LANDSAT data in mapping and monitoring mangrove areas in general and in detecting the various growth and structural characteristics of mangroves.

19495 Long- and short-term dynamic optimization models with application to the feeding strategy of the loggerhead shrike. Craig, R.B.; DeAngelis, D.L.; Dixon, K.R. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Am. Nat.;* **113**: No. 1, 31-51(Jan 1979).

Two dynamic optimization models, having scale lengths of 1 yr and 1 day, respectively, are used to gain insight into the feeding strategy of the loggerhead shrike. The need for at least two models underscores the fact that no single mathematical model is ever likely to describe all aspects of the feeding behavior of an organism. The long-term optimization model begins with the premise that total prey handling time is minimized, but the model is extended to a multiple objective scheme where handling time and weight are optimized simultaneously. The model indicated that it is optimal for shrikes to exceed 50 g in October and November, fall to about 45 g in December and January, and hover close to 50 g the rest of the year. These results are at least consistent with the small amount of data available on the weight of the shrikes. The model also predicts that the shrike should focus optimally on prey of size classes 5 and 6, in agreement with data. The short-term model attempts to account for the diversity of prey and the occurrence of uneconomical prey in the shrike's diet. If prey are unevenly available during the day, the shrike's hunger threshold frequently may be exceeded when only less preferred prey are obtainable. For 1 day in a a given month (September) the number of attacks per day, the frequency of attacks for different periods of the day, and the diversity of prey predicted by the model are in good agreement with corresponding observations.

RADIOMETRIC TECHNIQUES

REFER ALSO TO CITATION(S) 18914

19496 Sources of some obsidian flakes from a Paleoindian site in Guatemala. Stross, F.H.; Asaro, F.; Michel, H.V.; Gruhn, R. *Am. Antiq.;* **42**: No. 1, 114-118(Jan 1977).

Neutron activation analysis was used to determine the chemical composition of sources of obsidian artifacts from the Paleoindian site of Los Tapiales in Guatemala with an occupation date of around 10,700 radiocarbon years ago. Three different sources were detected, all between 50 and 75 km from Los Tapiales. The predominant source represented in our ten samples was in the Rio Pixcaya area, and another was in the Tajumulco area. A third source, identified by comparison with other work, appears to be in the area of San Bartolome Milpas Altas.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 18352, 18414, 19305, 19313, 19315, 19367, 19573

19497 (CONF-7804163—(Vol.1), pp 271-276) **Remote sensing and land use impact assessment.** Pierce, T.H.; Gustafson, J.R.; Koutsandreas, J. (Environmental Protection Agency, Washington, DC). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The relationship between land use and the environment is discussed. The environmental impact statement process is presented. Remote sensing is evaluated as a means for assessing land use impacts.

19498 (CONF-7804163—(Vol.2), pp 877-886) **Remote sensing of snowpack with microwave radiometers for hydrologic applications.** Shiue, J.C. (Goddard Space Flight Center, Greenbelt, MD); Chang, A.T.C.; Boyne, H.; Ellerbruch, D. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A microwave remote sensing of snowpack experiment is described and some preliminary data presented. A mobile field laboratory consisting of a four-frequency (5, 10.7, 18 and 37 GHz), all with dual linear (vertical and horizontal) polarizations, microwave radiometer system attached to a truck-mounted aerial lift was used to study the microwave emission characteristics of snowpacks in the Colorado Rocky Mountains during the winter of 1977-1978. The influence of snowpack physical parameters such as water equivalent, grain size, and melt-freeze cycle on its microwave brightness temperature and its implications to the application of microwave radiometric technique to remote sensing of snowpack for runoff prediction are discussed.

19499 (IVL-B—515) **Field analysis of metals using ring-oven technique.** Loevblad, G.; Andersson, K. (Swedish Water and Air Pollution Research Lab., Stockholm). Oct 1979. 19p. (In Swedish). Dep. NTIS (US Sales Only), PC A02/MF A01.

A portable ring-oven apparatus for analysis of trace metals in the environment has been constructed. The analysis method has been tested for some ten metals in the laboratory and in the field. The results show that the technique is viable, but can be rather complex and time-consuming.

19500 (ORNL/EIS—163/V1-P1) **Chemicals identified in human biological media, a data base. First annual report, October 1979 (Records 1-1580).** Cone, M.V.; Baldauf, M.F.; Martin, F.M.; Ensminger, J.T. (comps.). (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 314p. Dep. NTIS, PC A14/MF A01.

A comprehensive data base of chemicals identified in human biological media (tissues and body fluids) has been established under the direction of the Environmental Protection Agency's Office of Toxic Substances Survey and Analysis Division. This centralized resource of body-burden information has grown out of the concern of government scientists over continuing reports of toxic chemicals in human tissues and body fluids. These two volumes are the first annual publication of the data base. Body burden is a reflection of exposures to food, air, and water contaminants, as well as pharmaceutical administration. The systematic acquisition of body-burden data will facilitate a more relevant assessment of human exposure to xenobiotics (including toxic chemicals) than previously possible using environmental contamination levels.

19501 (ORNL/EIS—163/V1-P2) **Chemicals identified in human biological media, a data base. First annual report, October 1979 (Records 1-1580).** Cone, M.V.; Baldauf, M.F.; Martin, F.M.; Ensminger, J.T. (comps.). (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 816p. Dep. NTIS, PC A99/MF A01.

A comprehensive data base of chemicals identified in human biological media (tissues and body fluids) has been established under the direction of the Environmental Protection Agency's Office of Toxic Substances Survey and Analysis Division. This centralized resource of body-burden information has grown out of the concern of government scientists over continuing reports of toxic chemicals in human tissues and body fluids. These two volumes are the first annual publication of the data base. Body burden is a reflection of exposures to food, air, and water contaminants, as well as pharmaceutical administration. The systematic acquisition of body-burden data will facilitate a more relevant assessment of human exposure to xenobiotics (including toxic chemicals) than previously possible using environmental contamination levels.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

19502 (CONF-7804163—(Vol.3), pp 1995-2009) **Study of airborne gamma-ray spectrometry for geological mapping.** Slaney, V.R. (geological Survey of Canada, Ottawa, Ontario). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

To investigate the applicability airborne gamma-radiation surveys as aids in geological mapping, high sensitivity gamma-ray data were collected over 8000 km^2 in the Hearne Lake area of the Northwest Territories of Canada. The high sensitivity gamma-ray survey was flown at a nominal height of 120 m above ground with a line spacing of 2.5 km and at an average speed of 190 km/h. The spectrometer had three channels to measure ground concentrations of potassium, uranium, and thorium, and one broader total count channel to measure overall ground radioactivity. Twelve flight lines were selected as test lines, since they crossed most of the major rock types known to exist in the area. Color air-photographs were used to identify outcrops of each rock type and the distribution of overburden, swamp, and water. The average and standard deviation of the potassium, uranium, and thorium contents, as well as that of total radioactivity, were calculated for those measurements taken over outcrop. Similar calculations were performed on the three radioelement ratios; uranium/thorium, uranium/potassium and thorium/potassium. Using a maximum likelihood technique, it was found that by grouping the seventeen lithologic units into nine rock classes, approximately 80 percent of the 1730 airborne measurements within the test lines could be correctly identified. When the classification procedure was extended to the whole survey area, many rock units were found to have quite variable radiation patterns. In a few cases, similar rocks, located in different parts of the area, were found to have different radiometric signatures. Zones of anomalous high

radioactivity were often found to cross lithological boundaries and may be considered useful indicators for uranium exploration. (JGB)

19503 (PNL-SA—7497) **Potential radiological impact of a conceptual Hanford Nuclear Energy Center.** Soldat, J.K. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1978. Contract EY-76-C-06-1830. 32p. (CONF-790728—6). Dep. NTIS, PC A03/MF A01.

From 24. annual meeting of the Health Physics Society; Philadelphia, PA, USA (7 Jul 1979).

The potential radiological impact of the siting of 20 light-water reactors and associated nuclear fuel cycle facilities on the Hanford reservation was evaluated by calculating the potential radiation doses received by individuals and populations in the vicinity of the reservation. The largest contributor to the potential radiation doses, to both the individual and the 50-mile population, were the effluents from the conceptual 1500 MT/yr fuel reprocessing plant. The effluents from the 20 reactors combined was the second largest contributor. The radiation dose contributions from the 300 MT/yr mixed oxide fuel fabrication plant were insignificant. The highest organ dose from all facilities combined was 24 mrem/yr to the child thyroid; followed by 8 mrem/yr to the adult thyroid. The 50-year collective dose commitment to the population within 50 miles was about 50 man-rem for most organs of reference, while the estimate for bone was 70 man-rem. With the exception of ^{85}Kr, the release rates of radionuclides were within the EPA guidelines. Removal of about 90% of the 4×10^5 Ci/yr per gigawatt-year of electricity of ^{85}Kr from the fuel reprocessing plant gaseous effluents would be required for compliance with the EPA guidelines.

SOIL

REFER ALSO TO CITATION(S) 18447, 18453, 18454, 18455, 18456, 18457, 18459, 18460, 18462, 18477, 18478, 18950, 19199, 19200, 19224, 19225, 19226, 19228

19504 (LA—8183-T) **Radium-226 in vegetation and substrates at inactive uranium mill sites.** Marple, M.L. (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 75p. Dep. NTIS, PC A04/MF A01.

Thesis.

Results of a study of the content of radium-226 in plants growing on inactive uranium mill tailings sites in the Four Corners Region of the southwestern United States and in plants grown under greenhouse conditions with minimal surficial contamination are reported. Field plant samples and associated substrates were analyzed from two carbonate tailings sites in the Grants Mineral Belt of New Mexico. Radium activities in air-cleaned samples ranged from 5 to 368 pCi/g (dry weight) depending on species and location: activities in plants growing on local soils averaged 1.0 pCi/g. The talings and local soils contain 140 to 1400 pCi/g and 2.1 pCi/g, respectively. An evaluation of cleaning methods on selected samples showed that from 17 to 79% of the radium activity measured in air-cleaned samples was due to surficial contamination, which varied with species and location. A survey of 18 inactive uranium mill sites in the Four Corners Region was performed. Radium activity in plant tissues from nine species ranged from 2 to 210 pCi/g on bare tailings and from 0.3 to 30 pCi/g on covered tailings The radium content in most of the soil overburdens on the covered tailings piles was 10 to 17 pCi/g. An experiment was performed to measure radium-226 uptake by two species grown on tailings covered with a shallow (5 cm) soil layer. A grass, Sporobolus airoides (alkali sacaton) and a shrub, Atriplex canescens (four-wing saltbush), were studied. The tailings were a mixture of sands and slimes from a carbonate pile. The tailings treatments were plants grown in a soil cover over tailings; the controls were plants grown only in soil. Three soil types, dune sand, clay loam, and loam, were used. The radium activity of the plant tissue from the tailings treatment compared to that of the appropriate control was 1 to 19 times greater for the grass and 4 to 27 times greater for the shrub.

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 19504

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 18357, 18474, 18913, 18932, 18948, 18954, 18956, 19380, 19387, 19514, 19713

19505 (CONF-7804163—(Vol.1), pp 27-33) **Application of remote sensing in support of the national program for the inventory and evaluation of the country's natural resources.** Asmore, P. (National Coordination Agency for Surveys and Mapping, Jakarta, Indonesia). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Since 1976 the Indonesian Government has launched a comprehensive National Resource Inventory and Evaluation Program, encompassing the entire national land territory. This program has to be completed in the timespan of two Five Year Plans. The goals and objectives of the Program and the progmatic approach to its implementation are described. A most effective and efficient remote sensing system has been adopted, adapted to local conditions in regions outside Jawa. Program implementation integrates the resource inventory with base map production, providing the geometric base for data presentation and physical planning.

19506 (CONF-7804163—(Vol.1), pp 395-413) **Energy and remote sensing applications.** Summers, R.A. (Dept. of Energy, Washington, DC); Smith, W.L.; Short, N.M. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The United States National Energy Plan (NEP) and Nuclear Power Policy Statement of April 1977 constituted landmark events in US energy policy and planning. Effective implementation of these plans will require application of the best tools available. Implications for, and impacts upon developing countries need clarification. In context, the potential contributions of remote sensing, particularly LANDSAT data, have yet to be clearly identified and exploited. These contributions, ranging from the near-obvious to the more subtle, appear to fall into the following five categories: exploration by acceleration of the exploration process for naturally-occurring energy related materials, e.g., uranium, oil, gas; exploitation by improving the efficiency of extracting, processing and transporting identified mineral resources; power plant siting by more effective site selection for power installations and related infrastructure through improved assesment of geological hazards (fault identification), water needs/availability, and effluents; environmental assessment and monitoring through assistance in establishing environmental baselines related to energy production and in monitoring deviations, e.g., CO_2 monitoring, strip mining and land restoration; transportation infrastructure by providing improved mapping and monitoring capability to ensure design and operations of most efficient (minimum energy) transportation networks principally for developing countries. The collective impact of the five categories establishes a significant relationship between the growing needs for expanded but environmentally acceptable energy production and remote sensing.

19507 (CONF-7804163—(Vol.3), pp 1653-1664) **Remote measurements of vegetative cover in surface mines.** Carrel, J.E.; Johannsen, C.J.; Barney, T.W.; McFarland, W. (Univ. of Missouri, Columbia). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Vegetative ground cover, an important indicator of surface mine reclamation, can be remotely determined by two low cost, semi-automatic techniques. The first utilizes a leaf area meter to measure the extent of vegetation as represented by darkened spots on clear plastic overlays made from aerial photographs of minelands. The second utilizes an image analyzing computer to scan, digitize, and classify ground cover detected in the same aerial photographs. Both methods are rapid and highly (85 to 95%) accurate, although the computer system is more versatile. Digital image analysis can be coupled with many types of remotely sensed data to monitor surface mining and mineland reclamation anywhere in the world.

19508 (CONF-7804163—(Vol.3), pp 1743-1754) **Remote sensing for nuclear power plant siting, Bataan Peninsula, Republic of the Philippines.** Siegal, B.S.; Snider, F.G.; Tilford, N.R. (Ebasco Services, Inc., Greensboro, NC). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The siting of the first nuclear power plant in the Republic of the Philippines entailed an extensive remote sensing study to help evaluate tectonics, volcanism, and the structural setting of potential site regions. Over 10,000 square km of Side-Looking Airborne Radar was obtained, covering Mt. Pinatubo south to the Taal-Banahao volcanic area and from the west coast of Luzon east to Laguna de Bay; these data were analyzed concurrently with LANDSAT imagery, thermal IR imagery, and black and white and color aerial photography. Analysis included photographic processing, color additive viewing, Ronchi rulings and stereoscopic viewing, where applicable. Results of the remote sensing study, in conjunctin with seismological and field and laboratory analyses, provided an effective method of identifying and evaluating potential sites. Initial phases of the remote sensing study revealed that several of the proposed site regions were unsuitable because of fracturing, gravity movements, or volcanic hazards. SLAR imagery proved invaluable throughout the study in guiding field activities, unraveling structural settings and volcanic stratigraphy. As a result of the siting investigation, Napot Point was selected for the site of the first nuclear power plant in the Republic of the Philippines.

19509 (EPRI-FP—1207(Vol.1)) **Disposal of polychlorinated biphenyls (PCBs) and PCB-contaminated materials. Final report.**

(Stearns, Conrad, and Schmidt Consulting Engineers, Inc., Long Beach, CA (USA)). Oct 1979. 361p. NTIS.

This report presents background information and guidance for electric utilities seeking to dispose of polychlorinated biphenyls (PCBs) and PCB-contaminated materials in an environmentally acceptable and cost-effective manner. The report begins with an overview of PCB use in the United States, including estimated regional distribution in utility-owned electrical equipment. The current status of federal and state regulation of PCB waste management is described, along with permitting procedures and case studies. National and regional projection of utility-owned PCB liquids and solids disposal requirements, through the year 2017, are presented. The current status of approved, pending, and potential PCB disposal facilities is assessed on a regional basis and compared with regional demand. A review of research and state-of-the-art technology for PCB combustion is presented. Several combustion technologies are recommended for use in utility PCB disposal. Conceptual designs for these PCB preprocessing and combustion systems are presented in detail, along with the associated costs. The design criteria for PCB landfills are also reviewed. A conceptual PCB landfill design is presented, along with unit disposal costs for varying landfill capacities. Procedures to assist utilities in selecting a PCB landfill or combustion system are provided.

19510 (PB—296712) **Landsat project, State of Hawaii. A preliminary report.** (Hawaii Ad Hoc Committee on Remote Sensing, Honolulu (USA)). Dec 1978. 41p. NTIS, PC A03/MF A01.

An inter-agency task force comprised of representatives from the State of Hawaii Departments of Agriculture, Land and Natural Resources, and Planning and Economic Development. The past, present and potential future application of satellite remote sensing technology is examined as a possible means for meeting growing land use and environment-related information needs of the State of Hawaii.

19511 Response of reptile populations to different land management practices on the Idaho National Engineering Laboratory Site. Reynolds, T.D. *Great Basin Nat.;* **39**: No. 3, 255-262(30 Sep 1979).

Populations of reptiles were examined in grazed and ungrazed habitats dominated by sagebrush (Artemisia tridentata) or by rested wheatgrass (Agropyron cirstatum) on the Idaho National Engineering Laboratory (INEL) Site in southeastern Idaho. The sagebrush lizard (Sceloporus graciosus) and the short-horned lizard (Phrynosoma douglassi) were the only species of reptiles encountered in sufficient numbers to permit statistical analysis. Both of these species preferred sagebrush habitats to areas dominated by crested wheatgrass. The sagebrush lizard was most abundant in the native, ungrazed, sagebrush habitat, and the short-horned lizard was most plentiful in the sheep-gazed area dominated by big sagebrush.

19512 Competition between harvester ants and rodents in the cold desert. Landeen, D.S.; Jorgensen, C.D.; Smith, H.D. *Great Basin Nat.;* **39**: No. 3, 267-273(30 Sep 1979).

Local distribution patterns of three rodent species (Perognathus parvus, Peromyscus maniculatus, Reithrodontomys megalotis) were studied in areas of high and low densities of harvester ants (Pogonomyrmex owyheei) in Raft River Valley, Idaho. Numbers of rodents were greatest in areas of high ant-density during May, but partially reduced in August; whereas, the trend was reversed in areas of low ant-density. Seed abundance was probably not the factor limiting changes in rodent populations, because seed densities of annual plants were always greater in areas of high ant-density. Differences in seasonal population distributions of rodents between areas of high and low ant-densities were probably due to interactions of seed availability, rodent energetics, and predation.

19513 Food habits of burrowing owls in southeastern Idaho. Gleason, R.L.; Craig, T.H. (Univ. of Idaho, Moscow). *Great Basin Nat.;* **39**: No. 3, 274-276(30 Sep 1979).

Food habits of a population of the Burrowing Owl (Athene cunicularia) at the Idaho National Engineering Labortory, Butte County, were studied. The 421 pellets examined yielded 2,436 prey items of at least 22 prey species. Invertebrates, largely insects, constituted 91 percent of the total prey items, but only 29 percent of the total biomass; mammals constituted 8 percent of the prey items, but 68 percent of the biomass. The prey were mostly nocturnal species; diurnal species were poorly represented.

REGULATIONS

REFER ALSO TO CITATION(S) 18830

19514 (EPRI-FP—1207(Vol.2)) **Disposal of polychlorinated biphenyls (PCBs) and PCB-contaminated materials. Volume 2. Suggested procedure for development of PCB spill prevention control and countermeasure plans. Final report.** (Stearns, Conrad, and Schmidt Consulting Engineers, Inc., Redmond, WA (USA)). Oct 1979. 136p. NTIS.

Proposed legislation to strictly control the manufacturing, processing, distribution in commerce, and use of Polychlorinated Biphenyls (PCBs) included requirements for preparation of Exposure and Contamination Control (ECC) plans for PCB-related activities (40 CFR, Section 761.46, June 7, 1978). Just prior to the publication of this report, these requirements were modified in the final regulations, issued May 31, 1979, in the Federal Register. The requirement for Exposure and Contamination Control Plans was replaced by a Spill Prevention Control and Countermeasure (SPCC) Plan requirement under Section 311 of the Clean Water Act (40 CFR 112 and 43 FR 39276; September 1, 1978). This report was therefore updated to reflect the most current (May 31, 1979) regulatory requirements. Volume II provides utility engineers with specific guidelines for SPCC Plan preparation. Included are instructions relevant to Plan preparation, suggested blank forms for use in meeting SPCC Requirements, optional blank forms for further documentation of PCB Spill prevention and control at the facility level, examples of PCB Spill response and cleanup procedures, and a discussion of specific regulatory requirements. The plan format provides complete coverage of all SPCC regulatory requirements. The plan addresses certification, approval by management, conformance, records, inspections, drainage, containment, training, security, contingency planning and all other pertinent areas to SPCC planning. Also included are forms that focus on individual facilities where PCB control may also be important. These represent a separate and optional set of forms. They are provided for use where further precaution against PCB release to the environment is deemed useful by the utility. These forms focus on the more specific spill conditions in an individual facility rather than the general utility-wide perspective of the required forms.

19515 (DOE-tr—217) **Basic legislation.** 1977. Translation source not available. 36p. Dep. NTIS, PC A03/MF A01.

The management of natural resources in Brazil is discussed. The various agencies responsible for environmental protection and the decrees covering this area are reviewed. The creation of a Special Secretariat of the Environment is recommended and the responsibilities of that office are outlined. (DC)

ENVIRONMENTAL SCIENCES, AQUATIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 19288, 19353, 19356, 19357, 19360, 19373, 19375, 19376, 19377, 19378, 19382, 19383, 19388, 19389, 19391, 19392, 19393, 19397, 19423, 19441, 19442, 19448, 19451, 19484, 19489, 19502, 19552, 19587, 19722, 19729

19516 (BNL—5107) **Data report, oceanographic data from moored instrumentation: velocity, temperature, and salinity off Shinnecock, Long Island, in May 1977.** Hopkins, T.S.; Scott, J.T.; Pillsbury, R.D.; Divis, E.G.; Lofstrand, J. (Brookhaven National Lab., Upton, NY (USA)). Jul 1979. Contract EY-76-C-02-0016. 159p. Dep. NTIS, PC A08/MF A01.

Four instrumented moorings were deployed in the near-shore region off Shinnecock, Long Island, in May 1977. Each mooring had four sensor packages at distributed depths recording velocity, conductivity, and temperature over hourly intervals. The information was radioed to Brookhaven National Laboratory. Three moorings performed satisfactorily. Buoy 1 data suffered frequent gaps due to weak transmissions. The average period of operation was 25 days. The data are shown here through statistics, real-time plots, progressive vector diagrams, and stick figures of daily mean currents.

19517 (CONF-7804163—(Vol.1), pp 481-495) **Definition of hydrologic model parameters using remote sensing techniques.** Ragan, R.M. (Univ. of Maryland, College Park); Salomonson, V.V. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The use of Landsat remote sensing to define inmput parameters for an array of hydrologic models that are used to synthesize streamflow and water quality parameters in the planning or management process is discussed. The ground truth sampling and problems involved in translating the remotely sensed information into hydrologic model parameters are discussed. Another problem centers on the modification of existing models for compatibility with remote sensing capabilities. It is shown that the input parameters of many models are presently overdefined in terms of the sensitivity and accuracy of the model. When this overdefinition is recognized, many of the models currently considered to be incompatible with remote sensing capabilities can be modified to allow use with sensors having

rather low resolutions. Several successful hydrologic studies that have used remote sensing to define the input parameters are discussed. The use of Landsat digital data for several regional water resource planning studies involving areas in excess of 6,000 square kilometers is discussed. The planning jurisdiction involved achieved tremendous savings in time and money by converting the Landsat digital data into land cover for an array of cells that were then stored on conventional digital computers. Hydrologic parameters for individual watersheds or collections of watersheds distributed within the planning jurisdiction are obtained by accessing this digital geographical data base. This approach of storing land cover data on a conventional digital computer allows an easy technique for upgrading the data in those areas where more detailed information is available are where more sophisticated models must be used.

19518 (CONF-7804163—(Vol.1), pp 523-534) **Remote sensing of areal rainfall rates by a ground based microwave radiometer.** Dar-ren, L.; Hai, L.; Chi-i, J.; Hsiu-chi, C. (Inst. of Atmospheric Physics, Academia Sinica, Peking, China). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Primary results of verifications show that the microwave radiometer may be a useful tool for remote sensing of areal rainfall rates. The merit of rainfall measurements by a radiometer is that a reliable estimation of L/sub R/ may be obtained. Besides, the radiometer have merits of its light-weight, small size (except for the antenna which requires the same as the radar antenna), low power supply and easily operating. Its weakness is lack of range resolution. Technically, a radar-radiometer system can be developed with a common antenna. It is expected that the accuracy of areal rainfall rate distribution may be improved by use of such a system. A theoretical model was proposed for remote sensing of areal rainfall by a radar radiometer system. Much remains to be done to develop such a system to a practical rainfall measurement tool.

19519 (CONF-7804163—(Vol.1), pp 599-620) **Remote sensing of the oceans: a review.** Morgan, G.A. (Aircraft Research and Development Unit, Edinburgh, South Australia). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

With the imminent launching of SEASAT-A an historical perspective of events leading up to this pioneering develolpment is given and the evoluation of current spacecraft having ocean sensing capabilities is outlined. Applications of remote sensing of the oceans from space are described including some in the Australian region. The continuing role of man in space as an observer of the oceans is illustrated by a discussion of likely future developments in the SHUTTLE/SPACELAB era.

19520 (CONF-7804163—(Vol.1), pp 621-637) **Marine applications of the Nimbus-G coastal zone color scanner.** Vanselous, T.M. (National Space Technology Labs., NSTL Station, MS); Kemmerer, A.J.; Hovis, W.A.; Clark, D.K. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Theoretical investigations and studies with color sensors operated from ships and aircraft have demonstrated the feasibility of space measurements of ocean color. The NIMBUS-G spacecraft, scheduled for launch in August 1978, will carry a Coastal Zone Color Scanner (CZCS) designed for inferred measurements of chlorophyll and sediment concentrations, and possibly fish distribution patterns and physical features of ocean surfaces. Several investigations have been conducted using spectroradiometers, including an Ocean Color Scanner, to develop and test techniques for isolating ocean color data from atmospheric interference and extraction of usable information. A NIMBUS-G Experiment Team (NET) was formed to evaluate the technical performance of the CZCS and to develop algorithms for data analysis. Nine member experiments are scheduled. An intercalibration experiment was conducted during October 1977, with all NET members invoved to standardize surface truth measurement techniques and to acquire data for use in algorithm development. These algorithms are being designed to consider known optical properties of water, phytoplankton pigmentation and characteristics, and atmospheric attenuation.

19521 (CONF-7804163—(Vol.1), pp 639-651) **Overview of remote sensing oceanography in the United States.** Sherman, J.W. III. (National Oceanic and Atmospheric Administration, Washington, DC). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Key developments in remote sensing applications using surface, aircraft, and operational satellite systems are reviewed. Surface radars for real-time mapping of ocean currents over regions up to 70-km offshore, aircraft usng laser and radar systems for wave profiling and one-dimensional spectra, and the anticipated products from the TIROS-N satellite system are emphasized.

19522 (CONF-7804163—(Vol.1), pp 683-702) **Oceanic wave imagery and wave spectra distortions by synthetic aperture radar.** Raney, R.K. (Canada Centre for Remote Sensing, Ottawa); Lowry, R.T. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The problem of the observation of moving phenomena by scanning systems and the distortions involved are considered. The special problem of SAR imagery of ocean swell and existing models of imaging mechanisms are discussed. The importance of vertical scatterer movements in the orbital model for non-crested waves is emphasized. Examples are discussed that corroborate the model. Contrasts are drawn with examples of imagery from crested waves for which the substantially different phase speed model is suitable, again agreeing with selected examples. Results indicate that the most appropriate SAR observation model for uncrested waves is based on orbital motion of the capillaries with an explicit inclusion of the vertical component of the underlying gravity wave motion. For breaking or crested waves the most suitable model is based on phase velocity of the gravity wave field. Obvious features in imagery allow an interpreter to distinguish between these two cases. Results also indicate that any scanning sensing system is subject to distortions when observing a moving spatial phenomenon. Correction of these distortions is possible via a Lorentz-like transformation. (JGB)

19523 (CONF-7804163—(Vol.2), pp 845-855) **Quantitative evaluation of habitat conditions for effective waterfowl management by computer manipulation of LANDSAT classified data.** Colwell, J.E. (Environmental Research Inst. of Michigan, Ann Arbor); Roller, N.E.G.; Rebel, D.L.; Work, E.A.; Gilmer, D.S. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Activities oriented toward using LANDSAT data to assess waterfowl habitat quality are discussed. Two separate tasks are addressed: determination of number of ponds; and assessment of quality of habitat on the basis of presence, relative abundance, and spatial relationship of various terrain classes. The basic conclusions of this investigation are that LANDSAT data can be used in conjunction with a small, accurate double sample in order to make large area determinations of pond number, and that the information inherent in a LANDSAT recognition map may be useful for assessing waterfowl habitat quality.

19524 (CONF-7804163—(Vol.2), pp 907-915) **Large-scale demonstration of aquatic plant mapping by remote sensing.** Link, L.E.; Long, K.S. (Army Engineer Waterways Experiment Station, Vicksburg, MS). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A synopsis of the results of simulation modeling and field studies from which methodologies were formulated for application of remote sensing to the aquatic plant mapping problem is presented. A detailed discussion is presented of the conduct of large-scale field demonstration projects to evaluate the methodologies for their operational effectiveness.

19525 (CONF-7804163—(Vol.2), pp 1015-1024) **Analysis of the spatial and temporal distribution of surficial waters in the Minnedosa wetland district of Manitoba, Canada.** Steffensen, R.; Smith, A.M. (Geostudio Consultants Ltd., Ottawa, Canada). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A test study was conducted to ascertain the possibility of performing accurate estimates of spatial and temporal water distribution using LANDSAT imagery, without referring to ground-truth data. The problem consists of identifying myriads of ponds, which are scattered over the Minnedosa district, Manitoba, Canada, and which are close in size to the resolution limit of the LANDSAT multispectral scanner. Four LANDSAT images gathered in the period from spring to summer were selected, one from each year from 1973 to 1976. These four images were accurately registered, and a test site was outlined. Each digital image was independently classified using a newly developed multi-pass proportion estimation algorithm. This was designed to perform proportion estimation on pixels where mixtures of two different classes of terrain cover occur (including partial pixels of water classes). This was done in order to identify the percentage of water in pixels having only partial water coverage. Results were produced in the form of geometrically corrected images, by color encoding the percentage of water in each pixel. Subsequently, a comparison was made of water occurrences in the sequence of LANDSAT images by separating pixels where water is always present from pixels where water occurs intermittently. A table giving total water percentage in a given image area was also produced. The combination of interpreted data relating to variations in both space and time gives an accurate portrayal of the regime of surficial waters for the Minnedosa district. Estimates of cumulated water data computed for a selected surface area correlate well with pond index values obtained from aerial survey data gathered at low altitude over the Minnedosa district.

19526 (CONF-7804163—(Vol.2), pp 1025-1026) **Image enhancement of side-scan sonar mapping.** Luyendyk, B.P.; Hajic, E.J.; Simonett, D.S. (Univ. of California, Santa Barbara). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Information on environmental geology is needed to provide citizens, industry and government with a realistic and accurate estimate of the geologic hazards affecting present and future resource development in coastal areas (oil and gas, fisheries, mining). For example, at the present time many offshore oil installations, including the world's deepest water platform (in construction), are located in the fault-laced Santa Barbara Channel. Existing geophysical information, such as seismic reflection profiles, provides data mostly on older faults in deeper sub-bottom layers of the Channel. Side-scan sonar surveys will provide unique information on the character and stability of the sea bed itself. Although side scan sonar data collection techniques have been available for some years, a realization of the fuel potential of the floor imagery has been hampered by the typical hard copy paper output. In contrast, the collection of digitized sonar data opens it to the full potential of proven computer image processing and interpretation techniques. Side-scan sonar surveys of selected areas of the Santa Barbara Channel floor were started in fall 1977. Specific goals were to map the environmental geology of the seafloor, to enhance digitally the sonar images for improved geologic interpretation, and to identify a broadly applicable technology.

19527 (CONF-7804163—(Vol.2), pp 1053-1062) **Groundwater exploration in northwestern Tamil Nadu, India with LANDSAT data.** Vincent, R.K. (Geospectra Corp., Ann Arbor, MI); Scott, G.N.; Thillaigovindarajan, S. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Standard color composite and ratio color composite images of one half of a LANDSAT frame centered at 11° 27' N. latitude, 79° 6' E. longitude in northwestern Tamil Nadu, India, were employed for groundwater exploration. The region studied is almost completely comprised of crystalline rock, and contains very few producing water wells. Linear features suspected of being fractures were digitized, plotted and converted to fracture density contour maps for the half-frame. Three types of areas were selected as having good potential for groundwater exploration: areas with sharply truncated vegetation patterns, areas adjacent to isolated linear features in low fracture density regions, and areas of very high fracture density. This study resulted in the recommendation of areas for field resistivity measurements, which should be followed by drilling on the most favorable resistivity anomalies.

19528 (CONF-7804163—(Vol.2), pp 1063-1072) **Low cost hydrographic mapping.** Warne, D.K. (Australian National Univ., Canberra). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Several studies have demonstrated the feasibility of water depth mapping with LANDSAT, but the proposed techniques rely on optical characteristics being homogeneous throughout the survey area. This assumption breaks down in many areas where surveys are most needed. Research has resulted in a practical approach requiring integration of conventional techniques, LANDSAT and image interpretation. A specialized digital image analysis system has been developed for this purpose. Performance of the system under moderately adverse conditions is demonstrated by a test survey of the Endeavour Strait area off the north-east tip of Australia. Multiple images - either of different spectral bands or of different overpasses - are currently used as a cross-check on results, but a clustering approach to make greater use of multiple images is demonstrated. This approach reduces the cost of high quality charts by a factor of at least two and potential savings increase dramatically in situations where chart standards can be relaxed. Where there have been previous surveys, even though unreliable and incomplete, these may be used to further reduce costs.

19529 (CONF-7804163—(Vol.2), pp 1091-1102) **Airborne multispectral survey of intertidal vegetation in Alaska.** Polcyn, F.C. (Environmental Research Inst. of Michigan, Ann Arbor); Roller, N.E.G.; Zimmerman, S.; Gnagy, J. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Digital analysis was performed on a set of multispectral data collected by a low flying aircraft at study sites in the Gulf of Alaska for the purpose of mapping intertidal algal communities. Both supervised and unsupervised pattern recognition procedures were employed. Results show that it is possible to separate a scene into broad spatial zones corresponding to vegetation density for areas of low percent cover and algae types according to their taxonomic division (green, blue green, red, etc.) for areas with high levels of percent cover. Clustering techniques were found to be the most effective way to extract training signatures. A minimum of four spectral bands is needed to achieve the recognition performance levels demonstrated in this study. Two channels in the visible (green and red), one in the near-infrared region ($\sim$ 1.0μm) and one in the thermal region, were found most useful.

19530 (CONF-7804163—(Vol.2), pp 1103-1113) **Optical remote sensing of chlorophyll in ocean waters.** Wilson, W.H.; Austin, R.W.; Smith, R.C. (Univ. of California, San Diego La Jolla). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Ocean color remote sensing experiments were conducted in coastal waters utilizing measurements from high altitude aircraft coordinated with supporting measurements from surface vessels. The results of these experiments were used to study the significance of the various factors contributing to the apparent signals available to the remote sensor, to study methods for eliminating the masking effects of surface glitter and the atmosphere, and to develop effective methods for equating the remotely sensed signal with chlorophyll concentrations in the water. The airborne sensor was the Ocean Color Scanner developed at NASA/Goddard Space Flight Center. It maps the apparent radiance of the ocean surface below the flight track in ten narrow spectral bands. Measurements from the surface vessel included chlorophyll concentration and the attenuation properties of the water. Relationships were developed between water reflectance and chlorophyll concentration which can be used for predicting surface chlorophyll concentration remotely. These relations have been used to investigate the surface chlorophyll concentration in the New York Bight area.

19531 (CONF-7804163—(Vol.2), pp 1115-1126) **Radar monitoring of surface and internal glacial flow and iceberg movement.** Drake, B. (Old Dominion Univ., Norfolk, VA); Sivertson, W.E. Jr.; Jackson, P.L.; Larson, R.W. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The monitoring of glaciers, icebergs, and ice shelves can be achieved by the use of synthetic aperture radar (SAR) and buried transponders. Arrays of corner reflectors are placed on the ice surface and are imaged periodically by aircraft and eventually satellite SAR. The position of the reflectors can be determined on the SAR imagery with good accuracy. Successive imaging, which can occur in both cloudy weather and at night, gives the surface flow pattern, as well as the strain due to relative positions of the corner reflectors. In addition to surface flow, the flow at depth can be determined with the use of buried electromagnetic (EM) transponders. The EM propagation times between the transponders and transmitter-receivers at the surface can be used to determine the location of the transponders. Successive measurements of their locations will determine the flow rate at the depth of the transponder. A data collection platform (DCP) will be used for controlling the transmitter-receivers and storing data for later transmission to a satellite or other station. By these means a remote, accurate, and frequent measurement can be made of the surface flow of ice-shelves, the three-dimensional flow of glaciers, and the location and strain of icebergs.

19532 (CONF-7804163—(Vol.2), pp 1319-1327) **Comparative results of conventional and digital land cover collection methodologies for input to hydrologic modeling.** Sasso, R.R.; Mertz, F.C.; Estes, J.E.; Kraus, S.P. (Univ. of California, Santa Barbara). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Many empirical hydrologic models used by governmental agencies require soil and land cover data as input. The Kern County Water Agency (KCWA), California, employs such a watershed runoff prediction model developed by the US Department of Agriculture's Soil Conservation Service (SCS). The SCS model generates runoff curve numbers (CN) based upon the type, density and spatial distribution of soil and vegetation cover. KCWA currently uses field survey techniques to obtain soil cover equation coefficients for over 10,400 km^2 of mountainous watershed in Kern County. This method is both time consuming and expensive. Researchers of the Geography Remote Sensing Unit (GRSU), University of California, Santa Barbara, in cooperation with KCWA, have recently completed a comparison of conventional field techniques and digitally processed LANDSAT computer compatible tapes (CCT) for acquisition of land cover data inputs to the agency's watershed runoff prediction model. Runoff curve number accuracies for two test sites adjacent to Lake Isabella, in the southern Sierra Nevada foothills of California, indicate no significant differences between CN's generated by traditional ground survey techniques and CN's generated by the computer-aided method described. Furthermore, in the study area used for the research described herein, LANDSAT CCT's appear to provide a cost-effective method for the collection of vegetation and soil land cover data when compared to conventional ground surveys.

19533 (CONF-7804163—(Vol.2), pp 1431-1440) **First European ocean color scanner experiment in the southern bight of the North Sea - EURASEP Project.** Sorensen, B.M.; Sturm, B.; Mehl, W.; Maracci,

G. (Commission of the European Communities, Ispra(VA), Italy). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The NIMBUS-G satellite carrying the Coastal Zone Color Scanner (CZCS) will be launched in fall 1978. In order to prepare for the processng and interpretation of the satellite data, a number of pre-launch experiments have been coordinated and sponsored by NASA in the USA and by the Commission of the European Communities (CEC) in Europe. The most important European experiment was carried out in the summer of 1977, along the Dutch, Belgian, and French coast of the North Sea. A prototype instrument, the Ocean Color Scanner (OCS), on loan to the CEC from NASA, was flown on a high-altitude aircraft. A Bendix 11-channel scanner was flown on another aircraft at a lower altitude. The OCS data is only available on high density digital tapes, and not in a computer-compatible format at the time of writing. It will be analyzed in spring and summer 1978 to arrive at an interpretation algorithm, which ideally should be applicable to the CZCS data as well. A description is given of the computer processing of data acquired by the Bendix scanner to illustrate in part the anticipated approach for analyzing the OCS data. Correction of the scanner data for atmospheric path radiance is illustrated. A simplified theoretical method to correct for tidal current is shown. Grey level contouring on smoothed images of the selected channels which will be applied in the future interpretation algorithm for the OCS and CZCS is also shown. A simulation of the CZCS spatial resolution byy degrading the Bendix scanner resolution is illustrated.

19534 (CONF-7804163—(Vol.2), pp 1545-1553) **Application of satellite imagery to flood plain mapping in Thailand.** Whitehouse, G. (Water Resources Commission of New South Wales, Sydney, Australia); Ruangsiri, P.; Vibulsresth, S. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The first stage of any flood mitigation exercise must be the delineation of zones liable to flooding. In developing countries, however, planners are frequently confronted with the problem of inadequate hydrological data. Satellite imagery has proved to be a valuable adjunct to overcome this deficiency in the preparation of reconnaissance level flood plain mapping. It has also proved its usefulness for the formulation of water conservation and flood protection schemes. The practical application of satellite imagery to water resource development in northeastern Thailand is described. The study was undertaken as a co-operative effort by the Thai Government and the Australian Government (through the Australian Development Assistance Bureau) during October-November 1977.

19535 (CONF-7804163—(Vol.2), pp 1555-1561) **Systematic interdisciplinary analysis with stereo and transfer scope application.** Renz, C.E. (Corps of Engineers, Rock Island, IL). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A practical low-altitude remote sensing program that can be utilized in the planning and development of civil works projects was developed. Color infrared (CIR) film maintained on continuous rolls provides low-cost documentation of the District's waterways. Color positive transparencies can be viewed by stereo magnification and the imagery transferred to base maps of various scales by use of a Zoom Transfer Scope. In 1976, the District conducted a systematic interdisciplinary analysis as part of an intensive effort to apply new technology to achieve the most comprehensive examination practicable of environmental aspects of potential projects. The joint North Central Division (NCD)/Engineering Topographic Laboratory (ETL) Demonstration Study provided a vehicle for introducing the technique of interdisciplinary analysis of aerial imagery into the planning process of the North Central Division, Corps of Engineers.

19536 (CONF-7804163—(Vol.3), pp 1597-1608) **Modulation of the radar backscattering cross section by long ocean waves.** Alpers, W. (Univ., Hamburg, Germany); Jones, W.L. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The modulation transfer function which relates the backscattered microwave power to the long ocean wave field was measured in the North Sea during JONSWAP 75. Results from this tower experiment with an X-band scatterometer are presented and compared with the two-scale wave model (relaxation-time model).

19537 (CONF-7804163—(Vol.3), pp 1779-1789) **Soil moisture determination and snow classification with microwave radiometry.** Schanda, E. (Univ. of Berne, Switzerland); Hofer, R.; Wyssen, D.; Musy, A.; Meylan, D.; Morzier, C.; Good, W. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Results of investigations on the microwave emission of snow and soil under controlled conditions are reported. Three radiometers at 4.9, 10.5, and 21 GHz were used for the studies on soil moisture at three test sites, different in type of soil and covering a wide range of moisture contents, during the second half of 1977. Five radiometers at 4.9, 10.5, 21, 36, and 94 GHz are in use for the studies on the snow cover at a well-equipped high-altitude site, where all grades of snow are available during the seasons since early 1977. A classification of conventional snow parameters by the microwave emission due to a statistical algorithm yields very promising results.

19538 (CONF-7804163—(Vol.3), pp 1827-1835) **Application study of remote sensing to saury fisheries in Japan.** Saitoh, S.I. (Hokkaido Univ., Hakodate, Japan); Mishima, S.K.; Iisaka, J.; Asaoka, O. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

As a practical approach, an attempt was made to combine remote sensing data and data base management system for marine living resources assessment. A study area was chosen in the water off the Sanriku coast and saury Cololabis saira (brevoort) was chosen as the study resource. Commercial fishing data were prepared from the fisheries management data base and compared with LANDSAT MSS data by non-parametric clustering analysis. The high C.P.U.E. (catch per unit of fishing effort) cluster corresponded well with water class SEA-4 classified by the LARSYS program.

19539 (CONF-7804163—(Vol.3), pp 1837-1848) **Water management and control via the global meteorological satellite system.** Sharp, W.L. (Mississippi River Commission, Vicksburg). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A fully automated water resource data collection system is in the early stage of operation in the lower Mississippi River Basin by the Corps of Engineers (Corps). The Central Receive Site is located in the River & Reservoir Control Center of the Corps in Vicksburg, Mississippi. The initial phase of the system, which is designed to aid water control managers over a vast area, includes 57 reporting stations throughout the lower valley. Sixteen of the stations are on the main stem Mississippi River, 15 are at Corps reservoirs, 24 on principal tributaries, and 2 are on the Atchafalaya River outlet to the Gulf of Mexico. Seven of the stations are in the Cooperative Stream Gaging Program of the Corps and US Geological Survey. Several other offices of the Corps and National Weather Service located outside the lower valley are also using the Central Receive Site. All of the water data stations report to the Center via earth satellite every 4 hours, at which time data recorded at the sites within the 4-hour interval are also reported. All of the existing stations report water level. Precipitation is reported from most of the stations and water quality will ultimately be reported from several select stations. The principal physical components of the system consist of: automatic measuring equipment for the parameters just mentioned; environmental (water) data transmitters containing memory; earth satellites; a Central Receive Site; and a data communicatins processor (minicomputer) linked with small remote user terminals. These components are discussed in terms of their role in the system, including mention of special features. In addition, comparison with other more conventional data collection systems, the potential for technology transfer to other areas of the world, and some uses of the data are discussed very briefly.

19540 (CONF-7804163—(Vol.3), pp 2019-2026) **Photographic remote sensing at Chiba University (a) studies of Kumano River water and (b) analysis of concrete moisture by simulation.** Genda, H. (Chiba Univ., Japan); Okayama, H.; Ishiyama, T.; Takeda, K. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Image processing of an area photograph of the Kumano River water system in Japan is carried out by the use of a photographic technique of extraction of equidensity. The minimum extraction density range $\Delta D = 0.05$ is obtained by giving the film an exposure Epn which satisfies Log $Ep.n = \Sigma\ 0.05.n$. The result is displayed in false color and compared with that of ground truth. Secondly, it is of great interest to assess the concrete, which is widely used as building material, by means of remote sensing. The variance by different curing conditions of the concrete is observed by the photographic measurement and the measurement of the degree of polarization by use of a remote sensing simulator, and thereby the concrete moisture is estimated.

19541 (CONF-7804163—(Vol.3), pp 2027-2044) **Multi-level inventory and monitoring of wetlands on the Swan Coastal Plain, Western Australia.** Honey, F.R. (Division of Land Resources Management, Floreat Park, Western Australia); Hick, P.T.; Blatchford, D.R. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

There are several conflicting demands upon the wetlands of the Swan Coastal Plain, Western Australia, particularly near the rapidly developing state capital, Perth. A comparative study of the levels of detail obtainable usng LANDSAT imagery, aerial photography, ground survey and combinations of the three was undertaken.

Analysis of LANDSAT imagery was performed both by photo interpretation and by computer analysis of the computer compatible tape (CCT) data. After detailed cluster analysis and selection of appropriate signatures for vegetation, wet mud areas and areas subject to inundation, thematic maps were produced at a scale of 1:25,000 for comparison with the air photo interpretation and ground survey results. Aerial photography at scales ranging from 1:15,000 to 1:40,000 in panchromatic black and white, color and color infrared was used for mapping in more detail the vegetation associations in the wetlands. Ground survey indicated a strong correlation between the permanence of the wetland, depth and salinity and the vegetation species in and around the wetland. The various species could be mapped easily from the color and color infrared photographs. Ground survey was required for extracting detailed information on the suitability of the wetlands as breeding, feeding, and resting sites for water fowl. Samples were taken for analysis to determine chemical composition. Maps illustrating the results of the three survey methods are presented, and conclusions drawn of the suitability of each of the techniques for the different requirements in a monitoring scheme.

19542 (CONF-7804163—(Vol.3), pp 2071-2079) **Application of remote sensing in marine research in Indonesia.** Praseno, D.P. (Indonesian Inst. of Sciences, Jakarta); Soejoeti, Z.; Dijardjana. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Indonesia has recently begun to use remote sensing in oceanography. Some satisfactory results have been obtaned from aerial photography and satellite imagery. The best results were mainly obtaned from coastal regions. Other sensors, the radiometer and thermal scanner, are presently being tested. The technique and preliminary results are discussed.

19543 (CONF-7804163—(Vol.3), pp 2255-2266) **Use of LANDSAT data to minimize flooding risks caused by ice jams in Alaskan rivers.** Miller, J.M.; Osterkamp, T.E. (Univ. of Alaska, Fairbanks). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Breakup of ice in Alaskan rivers in late April or May customarily causes flooding from water backing up behind massive ice jams. Preventive measures normally include dusting the river ice with sand at critical locations in early April at the start of the melting season. To conserve costs of the dusting operations, more effective means are desired to predict the precise locations of the main river channels beneath the ice. LANDSAT data acquired during the fall freeze-up have been used to predict the locations of the main river channels to optimize the dusting operations performed the following spring. This technique should be operationally useful each year along the major river systems in Alaska such as the Yukon, Tanana, and Kuskokwim rivers which have many villages situated in the flood plain.

19544 (COO—1599-139(Pt.3)) **Interactions of carbon and nitrogen metabolism with changing light intensity in natural populations and cultures of planktonic blue-green algae.** Ward, A.K. (Michigan State Univ., East Lansing (USA). Dept. of Botany and Plant Pathology). 1978. Contract EY-76-S-02-1599. 89p. Dep. NTIS, PC A05/MF A01.

Thesis.

This study dealt with the factors contributing to the occurrence of blue-green algae in the plankton of lakes. Blue-green algal populations were examined in two different aquatic systems, moderately productive Lawrence Lake and hypereutrophic Wintergreen Lake, with regard to inorganic nitrogen source, light intensity and regime, and species of blue-green algae present. In order to understand the relationship between light and nitrogen source better among natural populations, representative species of blue-green algae, including isolates of Aphanizomenon flos-aquae, Microcystis aeruginosa, and Anabaena flos-aquae, were grown in laboratory cultures under continuously high, variable, and continuously low light at intensities similar to those in the lakes.

19545 (COO—3254-39) **In situ monitoring of the effects of water quality on benthic detrital decomposition.** Lee, J.J.; Mastropaolo, C.; McEnery, M.; Tietjen, J.H.; Garrison, J. (City Coll., New York (USA). Dept. of Biology). 1978. Contract EY-76-S-02-3254. 27p. Dep. NTIS, PC A03/MF A01.

Detrital decomposition is an important marine benthic process which contributes to the fertility of seas, particularly in estuarian and coastal waters. The process involves a complex community of microorganisms and small animals which interact with each other in a manner similar to that which occurs in forest litter and in composts. Plastic chambers for measuring decomposition rates of Spartina alterniflora were placed on the bottom of the sea at four sites in the northeast: Towd Point, Southampton, New York; the effluent quarry of the Millstone power plant on Niantic Bay, Long Island Sound; Winsor Cove, Cataumet, Massachusetts (the site of an oil spill); and Sippewissett marsh, Falmouth, Massachusetts (a control site for Winsor Cove). The stations were visited monthly. By various means we measured the rates of decomposition and growth of sediment microbial and animal populations.

19546 (EQL-Memo—22) **Conference on Western Water Issues held at the California Institute of Technology, May 17-18, 1979.** Isaacson, M.S.; Fall, T.C. (eds.). (California Inst. of Tech., Pasadena (USA). Environmental Quality Lab.). Sep 1979. Contract AG03-79EV10150. 190p. (CONF-7905141—). Dep. NTIS, PC A09/MF A01.

From Conference on western water issues; Pasadena, CA, USA (17 May 1979).

Over the last few years several potential conflicts have emerged over the manner in which water is put to beneficial use in the western United States. These potential problems have been further heightened by the western drought of 1976-1977 and by the recent upsurge of interest in developing western coal and oil-shale resources. The conference on Western Water Issues, held at the California Institute of Technology, 17-18 May 1979, provided a forum for representatives of industry, agriculture, government, environmental groups, research establishments and universities to exchange ideas on the subject. Most of the discussions centered on California and the Colorado River Basin. Specific items discussed included climatic fluctuations and predictability of the basic water supply; existing water law and needed changes; economics of water and the lack of real water markets; pending California state legislation (on the Peripheral Canal in the Sacramento-San Joaquin Delta area, and on limits to pumping overdrafted ground water basins); water availability for energy resurces development; and competing needs by municipalities, industry, and agriculture. As a summary of the conference this report should be regarded as a source book to clarify the issues and direct the reader to relevant individuals and references.

19547 (PB—80-105992) **Water withdrawals in Illinois, 1978.** Kirk, J.R.; Jarboe, J.; Sanderson, E.W.; Sasman, R.T.; Sinclair, R.A. (Illinois State Water Survey, Urbana (USA)). 1979. 40p. NTIS, PC A03/MF A01.

This report, part of a continuing cooperative program with the U.S. Geological Survey, summarized the results of the 1978 Illinois Water Use Inventory. The water use data were presented for the following categories: Public Water Supply (1770.9 mgd), Self-Supplied Industry (44,331.0 mgd), Rural Water Use (220.0 mgd), and Fish and Wildlife Management Areas (44.2 mgd). The data were then further categorized by county, districts, hydrologic units, and Standard Metropolitan Statistical Areas.

19548 **Coastal boundary layer.** Csanady, G.T. (Woods Hole Oceanographic Inst., MA). pp 57-68 of Estuaries, geophysics, and the environment. Washington, DC; National Academy of Sciences (1977).

The coastal boundary layer is a zone where the effect of the coast on the hydrodynamics of the flow is pronounced. An empirical definition of the coastal boundary layer is advanced and several conceptual models are described. (ACR)

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REFER ALSO TO CITATION(S) 18348, 18352, 18878, 19305, 19313, 19360, 19367, 19573

19549 (ANL/EMR—2(Vol.2A)) **Environmental control technology survey of selected US strip mining sites. Volume 2A: Ohio: water quality impacts and overburden chemistry of Ohio study site.** Bogner, J.E.; Henricks, J.D.; Olsen, R.D.; Schubert, J.P.; Sobek, A.A.; Wilkey, M.L.; Johnson, D.O. (Argonne National Lab., IL (USA)). May 1979. Contract W-31-109-ENG-38. 146p. Dep. NTIS, PC A07/MF A01.

As part of a program to examine the ability of existing control technologies to meet federal guidelines for the quality of aqueous effluents from coal mines, an intensive study of water, overburden, and coal chemistry was conducted at a large surface mine in Ohio from May 1976 through July 1977. Sampling sites were chosen to include the final mine effluent at the outflow of a large settling pond and chemically-treated drainage from a coal storage pile. Samples were collected semimonthly and analyzed for total dissolved solids, total suspended solids, alkalinity, acidity, sulfate, chloride, and 16 metals. Field measurements included pH, flow rate, dissolved oxygen, and specific conductance. The final effluent, where sampled, generally complied with Office of Surface Mining reclamation standards for pH, iron, and total suspended solids. Comparison of the final effluent with water quality of an unnamed tributary above the mine suggested that elevated values for specific conductance, total dissolved solids, sulfate, calcium, magnesium, manganese, and zinc were attributable to the mine operation. In general, there were observable seasonal variations in flow rates that correlated positively to suspended solids concentrations and negatively to concentrations

of dissolved constituents in the final effluent. Drainage from the coal storage pile contained elevated levels of acidity and dissolved metals which were not reduced significantly by the soda ash treatment. The storage pile drainage was diluted, however, by large volumes of alkaline water in the settling pond. Analysis of overburden and coal indicated that the major impact of mine drainage was pyrite oxidation and hydrolysis in the Middle Kittanning Coal and in the Lower Freeport Shale overlying the coal. However, the presence of a calcite-cemented section in the Upper Freeport Sandstone contributed substantial self-neutralizing capacity to the overburden section, resulting in generally alkaline drainage at this site.

19550 (CONF-7804163—(Vol.1), pp 235-238) **Control of oil pollution by remote sensing along the shores of France.** Mourlon, J.C. (Embassy of France, Washington, DC). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Results of two operational campaigns of aerial surveillance of illicit oil discharges off the French coasts of the English Channel and Atlantic Ocean are presented. Equipment for the remote sensing by infrared radiometry (land, air, and sea) is described. During the first campaign, Project Surpolmer 76, from November 1976 to February 1977, monitoring was conducted for 66 days, totaling 170 hours of flight. 1148 ships were surveyed and 14 infractions were recorded. During the second campaign, Project Surpolmer 77, which was carried out from August 22 until December 8, 1977, 77 days of surveillance allowed the monitoring of 1115 ships in 236 hours. Among the 1115 ships monitored, 23 oil discharges were recorded, of which 15 were particularly significant. Nine were judged sufficiently large to be investigated further by the legal authorities. (JGB)

19551 (CONF-7804163—(Vol.1), pp 239-255) **Remote sensing for oil pollution control along coastal waters of the United States.** White, J. (Coast Guard Office of Research and Development, Washington, DC); Breslau, L.R. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

In order to effectively perform its marine environment protection mission, the Coast Guard has augmented its airborne patrols with remote sensing systems. Several of the objectives of the remote sensing system are: eliminate the deliberate discharge of oil through improved detection capabilityy and subsequent prosecution of violators; provide early warning of unreported spills that threaten coastal areas so that appropriate cleanup and protective action can be taken; and assist the on-scene coordinator and other cleanup personnel by providing information on the location, quantity, and movement of a spill. The objectives indicate that the essential requirements of an operational airborne surveillance system are that it be able to detect the illegal pollution activity, identify a violator if possible and confirm the discharge event, and provide data that can be used in the event of subsequent legal proceedings, such as pollutant quantity, accurate position, etc., in near real time, under all-weather, day/night conditions. The Coast Guard has successfully developed an operational airborne surveillance system and is currently conducting routine surveillance patrols with the systems called Airborne Oil Surveillance Syystem-II (AOSS-II) which evolved from predecessor systems called the Airborne Remote Sensing System (ARRS) and the Airborne Oil Surveillance System-1 (AOSS-I). The currently operational AOSS-II system is destined to be superceded by a system currently under development calld the Airborne Remote Instrumentation System (AIREYE).

19552 (CONF-7804163—(Vol.1), pp 445-462) **Satellite surveillance of physical water-quality characteristics.** Moore, G.K. (Geological Survey, Sioux Falls, SD). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

Remote sensing instruments obtain an optical measure of water color and turbidity. Color increases the absorption of light in water and decreases the remotely sensed signal; turbidity increases the backscatter of light. A combination of dark-object-subtraction and band ratios may produce an adequate atmospheric and sun-angle correction, but this technique needs to be tested. If this technique proves satisfactory, LANDSAT data will have value as a record of water color and turbidity. Satellite surveillance presently is evaluated as a costly way of obtaining information, but several potential applications may be economical. These include the use of turbidity as an index to streamflow velocity and to the productivity of lakes, estuaries, and oceanic fishing grounds.

19553 (CONF-7804163—(Vol.1), pp 463-479) **Remote sensing floods and flood plains, Victoria, Australia.** Currey, D.T. (State Rivers and Water Supply Commission, Victoria, Australia). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A presentation is given of the historic progression of the uses of remote sensing techniques for soil surveys geomorphic and flood studies which have been initiated in Victoria to provide basic information for regional planning and flood plain management.

19554 (CONF-7804163—(Vol.2), pp 1309-1318) **Quantitative description and analysis of remotely sensed water quality distribution.** Yasuoka, Y.; Iikura, Y.; Miyazaki, T. (National Inst. for Environmental Studies, Ibaraki, Japan). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A quantitative method is devised for describing and analyzing remotely sensed distribution patterns. Three stages for the analysis are discussed. Firstly, there is proposed a method for measuring water quality distribution quantitatively by correlating the remotely sensed multispectral data with the ground truth data. Secondly, a procedure is developed for extracting the quantitative features of the obtained pattern in order to describe and analyze its macroscopic characteristics and to put it into practical use. Fourier Transformation has been shown to be effective for this purpose. Finally, an attempt is made of devising a statistical model to estimate the distribution pattern only from the discretely monitored data on the ground. This model is constructed by correlating the extracted features of the remotely sensed patterns with the corresponding data on the ground by the use of regression analysis.

19555 (CONF-7804163—(Vol.2), pp 1367-1377) **Sediment/siltation monitoring within a tidal basin using repetitive LANDSAT CCT data.** Thomas, I.L. (Physics and Engineering Lab., Lower Hutt, New Zealand). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A feasibility study on the use of repetitive LANDSAT MSS CCT data for monitoring suspended sediment and siltation dynamics in a tidal basin is reported. It was found that such repetitive satellite coverage complements and extends available bathymetric and tidal data. Horizontal and vertical movements of suspended sediment may be followed using all four MSS bands with the difference between sediment and siltation dynamics being further resolved by repeated satellite coverage. In this study penetration depths of 45 to 50 cm and 10 to 15 cm were found for channels MSS 5 and MSS 6 over such a sediment-laden tidal inlet.

19556 (CONF-7804163—(Vol.2), pp 1379-1389) **Detection of eutrophication processes from air and space.** Horstmann, U. (Univ. of Kiel, Germany); Ulbricht, K.A.; Schmidt, D. 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

LANDSAT scenes of the Baltic disclose patterns in its four multispectral channels which differ in their reflection from the surrounding water. Application of digital image processing system modules and presentation in false colors displays the appearance of an eutrophication phenomenon, the mass occurrence of the blue-green algae Aphanizomenon flos-aquae and Nodularia spumigena in the Baltic. Blooms are considered to be stimulated by phosphorus discharge into the Baltic and favored by the fact that these blue-green algae fix nitrogen from the air. In summer the algae sediment to the surface and are thought to drift towards the center of the Baltic. They are described as nutrient and food supply for other organisms of the pelagial. General potentials of remote sensing of eutrophication processes are discussed.

19557 (CONF-7804163—(Vol.3), pp 1791-1798) **Detection and monitoring of water hyacinth (Eichhornia crassipes) infestation in Laguna de Bay through multispectral digitral analysis of LANDSAT imageries.** Bina, R.T.; Jara, R.; Lorenzo, E.; de Jesus, B. Jr. (Natural Resource Management Center, Quezon City, Philippines). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

In an effort to determine the potential of LANDSAT data in the detection and monitoring of water hyacinth (Eichhornia crassipes) infestation in Laguna de Bay, the Natural Resources Management Center conducted initial studies to find out what information are obtainable from LANDSAT data, in preparation for LANDSAT C Program. Preliminary results indicate that a number of information vital in the management of water hyacinth infestation such as patterns of distribution, density estimates, area coverage, etc. can be obtained from LANDSAT data through visual and digital analysis using the Image 100 System.

19558 (CONF-7804163—(Vol.3), pp 1937-1946) **Spectral characteristics in uv-v-ir of materials in Requena and La Esperanza dams and their detection by remote sensing.** Ruiz Azuara, P.; Lemus Hidalgo, L. (Universidad Nacional Autonoma, de Mexico, Mexico City). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The spectral characteristics of some materials which were reported in the chemical analysis as possible compounds in an early study of total suspended solids realized by remote sensing in the Requena Dam had been studied using ultraviolet, visible, and in-

frared spectroscopies. Three regions of the electromagnetic spectrum in which some of these materials can be distinguished in aqueous solutions had been found. They are: .2 to .36 μ, 6.5 to 8.5 μ, and 8.5 to 10.5 μ. Assuming additivity these results can be used to interpret in a first approximation the spectra of water samples that were taken in La Esperanza Dam. The problems related with the use of the partial transmissibility as a selective indicator in water quality studies by remote sensing were discussed.

19559 (CONF-7804163—(Vol.3), pp 2307-2311) **US Coast Guard utilization of remote sensing techniques for ocean surveillance.** White, J.R.; Freezer, D.R.; Vollmers, R.R. (Coast Guard, Washington, DC). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

The US Coast Guard performs a number of missions, e.g. pollution surveillance, search and rescue, ice reconnaissance, and enforcement of laws and treaties, which require large scale ocean surveillance. Evaluation of numerous types of sensor systems has shown that these missions can be performed more effectively by using sensor-equipped aircraft. Some recent Coast Guard research and development programs in remote sensing are discussed.

19560 (COO—2185-12) **Transport and transfer rates in the waters of the continental shelf.** Biscaye, P.E. (Columbia Univ., Palisades, NY (USA). Lamont-Doherty Geological Observatory). Aug 1979. Contract EY-76-S-02-2185. 160p. Dep. NTIS, PC A08/MF A01.

Samples and data from previous cruises were analyzed with a view to understanding those biological, chemical, and physical processes which affect energy-related pollutants in the marine environment of the continental margin. Two cruises designed to expand the sample base, measure the time variability of several transfer processes, and to test specific hypotheses on the mechanisms for processes which effect exchange of continental margin with open ocean waters were carried out. Progress was made in understanding the relative roles of nutrients and light in controlling the productivity of important primary biomass (and hence, particle) producers. Progress was also made in understanding the influences of phytoplankton populations on distribution of inorganic nutrients, dissolved oxygen and particulate organic matter. In addition, preliminary results from field work support the hypothesis that most diatom production on the shelf sinks to the bottom where it enters benthic food chains or provides seed populations for subsequent blooms. Radionuclides were studied in water columns and in sediments to develop an understanding of processes associated with suspended solids and with sediments as sinks for radionuclides and other pollutants. Major progress was made on the analysis of hydrographic data from all previous cruises and to evolve a comprehensive picture of the stratification of the waters of the New York Bight. The Co_2-H_20 equilibration system required for the preparation of samples for oxygen isotope analysis was completed. Work has continued in the use of radon as a tracer of small scale water motions and mixing in the definition of the source function needed for modelling the data, in actual modelling of the data, and in defining the range of variability of the radon distributions. (JGB)

19561 (DOE/EV/70001—T1) **Transport and reaction of heavy metals in Alaskan fjord-estuaries. Annual report, July 1, 1978-June 30, 1979.** Burrell, D.C. (Alaska Univ., Fairbanks (USA). Inst. of Marine Science). Jun 1979. Contract EY-76-S-06-2229-001. 123p. Dep. NTIS, PC A06/MF A01.

An analysis of regional hydrography and nutrient and suspended sediment chemistry data are analyzed for Boca de Quadra inlet and Resurrection Bay, Alaska. The character and transport of suspended sediments are discussed. Other topics include: benthic flux and near bottom reactions of heavy metals in fjords; deep water exchange in Alaskan sub-arctic fjords; sediment-seawater exchanges of nitrogen and transition metals in an Alaskan fjord; reaction and flux of manganese within the oxic sediment and basin water of an Alaskan fjord; deep water renewals in Resurrection Bay, Alaska; the behavior of iron, manganese, and zinc in a heavily polluted river-estuary system. (DC)

19562 (IVL-B—518) **Flow in the sea of heavy metals from a smelter industry.** Hellstroem, T. (Swedish Water and Air Pollution Research Lab., Stockholm). Oct 1979. 137p. Dep. NTIS (US Sales Only), PC A07/MF A01.

This report is dealing with the transports of lead, copper and cadmium within the Gulf of Bothnia. The aim is to predict the concentrations of the metals and the sedimentation rates in the sea as a function of the emissions. For this purpose a metal flow model has been developed. Processes taken into account in the model are current patterns, flocculation, settling and sediment leaching. The current patterns are estimated based on measurements in situ. The flocculation, settling and sediment leaching have been estimated based on lab experiments.

19563 **Bioaccumulation potential of polycyclic aromatic hydrocarbons in Daphnia pulex.** Southworth, G.R.; Beauchamp, J.J.; Schmieder, P.K. (ORNL). *Water Res.;* **12**: No. 11, 973-977(1978).

The extent of and rate at which polycyclic aromatic hydrocarbons (PAH's) are removed and accumulated by the aquatic zooplankter Daphnia pulex are studied. Bioaccumulation data are analyzed as a first-order approach to equilibrium in a two-compartment model. PAH's are concentrated from a high of about 10,000 fold for benz(a)anthracene to a low of about 100 fold for naphthalene. (2 graphs, 15 references, 2 tables)

19564 (PB—80-110299) **Development document for effluent limitations guidelines and new source performance standards for the mineral mining and processing point source category. Final report.** Costle, D.M.; Jorling, T.C.; Davis, S.T.; Schaffer, R.B.; Kirby, R.G. (Environmental Protection Agency, Washington, DC (USA). Effluent Guidelines Div.). Jul 1979. 468p. NTIS, PC A20/MF A01.

This document presents the findings of an extensive study of the mineral mining and processing industry for the purpose of developing effluent limitations guidelines for existing point sources and standards of performance and pretreatment standards for new sources, to implement Sections 301, 304, 306 and 307 of the Federal Water Pollution Control Act, as amended (33 U.S.C. 1551, 1314, and 1316, 86 Stat. 816 et. seq.) (the 'Act'). Effluent limitations set forth the degree of effluent reduction attainable through the application of the best practicable control technology currently available (BPCTCA) and the degree of effluent reduction attainable through the application of the best available technology economically achievable (BATEA) which must be achieved by existing point sources by July 1, 1977 and July 1, 1983, respectively. The standards of performance (NSPS) and pretreatment standards for new sources set forth the degree of effluent reduction which are achievable through the application of the best available demonstrated control technology, processes, operating methods, or other alternatives. Supporting data and rationale for development of the effluent limitations guidelines and standards of performance are contained in this report.

19565 (PB—80-112964) **The disinfection of drinking water. Final report.** (National Research Council, Washington, DC (USA)). Mar 1979. Contract EPA-68-01-3169. 234p. NTIS, PC A11/MF A01.

The current status of theoretically possible methods for disinfecting drinking water is reviewed. The specific biocidal activity of each of the disinfectants is considered, as well as information (or lack of it) on the practical application and reliability of the methods.

19566 (PB—80-801319) **Water pollution in estuaries and coastal zones. Volume 2. 1975-October 1978 (a bibliography with abstracts). Report for 1964-October 1978.** Brown, R.J. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 258p. NTIS PC N01/MF N01.

The bibliography contains selected abstracts of research reports covering studies dealing with water pollution from estuarine and coastal development, the effects of this pollution, and its control. The reports are general in nature so as to be of interest to any coastal area. The topics include pollution as related to urbanization, government actions, coastal planning, natural resource development, and sewage and solid waste disposal. Specific biological and oceanographic studies have been excluded. (This updated bibliography contains 252 abstracts, none of which are new entries to the previous edition.)

19567 (PB—80-801327) **Water pollution in estuaries and coastal zones. Volume 3. 1978-October 1979 (a bibliography with abstracts). Report for 1978-October 1979.** Brown, R.J. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 76p. NTIS PC N01/MF N01.

The bibliography contains selected abstracts of research reports covering studies dealing with water pollution from estuarine and coastal development, the effects of this pollution, and its control. The reports are general in nature so as to be of interest to any coastal area. The topics include pollution as related to urbanization, government actions, coastal planning, natural resource development, and sewage and solid waste disposal. Specific biological and oceanographic studies have been excluded. (This updated bibliography contains 70 abstracts, all of which are new entries to the previous edition.)

19568 (RLO—2227/T29-10) **Mesoscale studies of flow regimes and fluxes of particulate matter in coastal waters.** Nelson, D.M.; Pak, H.; Small, L.F.; Zaneveld, J.R.V. (Oregon State Univ., Corvallis (USA). School of Oceanography). Mar 1980. Contract EY-76-S-06-2227-029. 44p. Dep. NTIS, PC A03/MF A01.

Progress for the entire three year period is reported. Research includes the following subject areas: (1) seasonal effects on the distributions and movements of suspended particulate matter (spm) in a near-coast region of smooth bathymetry; (2) summer effects on the distribution and movement of spm in a submarine canyon; (3) development of a numerical model of time-space distribution of spm in a near-coast region of smooth bathymetry; (4) fractionation of spm

into organic and inorganic fractions; (5) identification of sources, sinks, and fluxes of different compartments of the spm; and (6) development of in situ instrument packages. (ACR)

19569 Interactive system for time-series analysis and display of water quality data. Phillips, R.L.; Cederquist, G.N. (UNIDATA, Inc., Ann Arbor, MI). pp 37-41 of Proceedings of the fifth biennial international CODATA conference. Dreyfus, B. (ed.). Elmsford, NY; Pergamon Press Inc. (1977).

From 5. CODATA conference; Boulder, CO, USA (28 Jun 1976).

The development of the ADROIT system (2) (Automated Data Retrieval and Operations Involving Timeseries) was undertaken to alleviate the shortcomings of the STORET system for use within the State of Michigan. ADROIT is a system of integrated computer programs which have been designed to perform rapid retrieval and statistical analysis of water quality time-series data, and to produce report-ready graphs of selected results. ADROIT caters both to the casual browser who is taking a cursory look at a small data set and to the more serious investigator rigorously studying a large data set. For casual and exploratory studies, ADROIT is usually run completely interactively. After an analysis scheme has been interactively developed and verified, further analyses and/or plotting of results may be performed without user intervention. ADROIT is currently implemented as two intercommunicating interpreters, each of which communicates with the user through its own special-purpose programming language. The interpreters are known as the ADROIT Computational Subsystem (ACS) and the ADROIT Display Subsystem (ADS).

19570 Nutrient and particulate matter budgets in urban estuaries. Simpson, H.J.; Williams, S.C.; Olsen, C.R.; Hammond, D.E. pp 94-103 of Estuaries, geophysics, and the environment. Washington, DC; National Academy of Sciences (1977).

The distribution of phosphate in the Hudson Estuary and the rate of loading from sewage outfalls is described in terms of a very simplified descriiption of water circulation and phosphate behavior in the harbor region adjacent to New York City. Phosphate is the nutrient most frequently considered for nutrient removal from sewage effluent and is somewhat simpler to treat in estuarine budgets than nitrogen. Nutrient distributions in the Hudson are compared with those in San Francisco Bay to indicate the first-order similarities of nutrient-algae relationships in these two systems. (ACR)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 19178, 19502

19571 Patterns of deposition of natural and fallout radionuclides in the sediments of Lake Michigan and their relation to limnological processes. Edgington, D.N. (Argonne National Lab., IL); Robbins, J.A. pp 705-729 of Environmental biogeochemistry. Vol. 2. Nriagu, J.O. (ed.). Ann Arbor, MI; Ann Arbor Science Publishers, Inc. (1977).

From 2. international symposium on environmental biogeochemistry; Burlington, Ontario, Canada (8 Apr 1975).

Results are reported on the measurement of ^{210}Pb, ^{137}Cs, and ^{239}Pu in sediment cores taken mainly from southern Lake Michigan. The concentration profiles vary considerably from station to station depending upon sedimentation rate and other limnological factors. The profiles were interpreted in terms of a simple model which allows the calculation of a sedimentation rate.

WATER

REFER ALSO TO CITATION(S) 18458, 18460, 18470, 18477, 19560

AQUATIC ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 18470

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 18877, 19704

19572 Unusual population size structure in freshwater turtles on barrier islands. Gibbons, J.W.; Keaton, G.H.; Schubauer, J.P.; Greene, J.L.; Bennett, D.H.; McAuliffe, J.R.; Sharitz, R.R. (Savannah River Ecology Lab., Aiken, SC). Contract EY-76-C-09-0819. *Ga. J. Sci.*; **37**: No. 3 and 4, 155-159(Jun 1979).

Slider turtles, Chrysemys scripta, attain biologically and statistically significantly larger sizes on Atlantic Coast islands than do natural populations on the mainland. The sizes of individuals on these islands are comparable to those reported previously for turtles from unique aquatic situation in a thermally altered reservoir. Higher quality diets and warmer temperatures appear to be satisfactory explanations for the island and reservoir situations.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 18913, 19546

REGULATIONS

REFER ALSO TO CITATION(S) 18964, 19515, 19546

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 18374, 18927

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 19304, 19573

19573 (ANL/AA—15) Proceedings of the National Ecological Assessment Workshop. Ballou, S.W.; Robeck, K.E. (eds.). (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 64p. Dep. NTIS, PC A04/MF A01.

methods for evaluating the potential for ecological impacts resulting from the deployment of conventional and nonconventional energy systems are not yet well developed. The varying spatial and temporal scales often used in these assessments complicate the ecological analyses. This report presents the results of a three-day workshop to which ecologists and energy decision makers were invited in order to address these problems. The goals of the meeting were: (1) to discuss and identify the ecological concerns that should be addressed in energy technology assessments, (2) to establish which concerns can be adequately addressed with current knowledge and methods, (3) to suggest additional methods and data bases that might be developed, and (4) to address the temporal and spatial scale problems encountered in energy technology assessments. The discussions focused on three areas: ecological processes, populations of organisms, and ecosystems. The results of the workshop provide a framework for the continuing development of ecological assessment methods.

ENVIRONMENTAL IMPACT STATEMENTS

19574 (ORNL/TM—7101) Preliminary draft: environmental impact statement for Hot Fuels Engineering Laboratory. Boyle, J.W.; Carpenter, J.A. Jr.; Cotter, S.J.; Harrington, F.E.; Hinkle, N.E.; Johnson, D.R.; Kroodsma, R.L.; Lin, K.H. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 175p. Dep. NTIS, PC A08/MF A01.

The proposed action considered in this report is the construction and operation of the Hot Fuels Engineering Laboratory (HFEL) to be located in Building 7930, the Thorium-Uranium Recycle Facility (TURF), at Oak Ridge National Laboratory. The successful operation of the HFEL, as described in this report, will provide generic demonstrations of safe, economical fuel fabrication processes for fuels which are inherently highly radioactive or fuels to which a high level of radioactivity has been added to reduce the probability of illicit diversion. The proposed action will demonstrate the process and equipment remote operability with high levels of radioactivity present (up to 10,000 R/h). Three fuel fabrication processes will be tested: the gel-sphere-pac and sphere-cal processes for metal clad fuel pins and the production of HTGR-green-fuel-rods for insertion into graphite elements. Each process will be tested for two types of fuel: uranium-plutonium and ^{233}U-thorium. In each case, the product will be a small number of fuel pins or rods, which will be suitable for testing in other phases of the National Program Plan of the Department of Energy. The facility will accommodate other types of fuels and processes if so desired. (PCS)

BIOMEDICAL SCIENCES, BASIC STUDIES

BEHAVIORAL BIOLOGY

REFER ALSO TO CITATION(S) 18946, 19572, 19653

19575 Behavioral toxicity tests. Laties, V.G.; Dews, P.B.; McMillan, D.E.; Norton, S.E. pp 111-118 of Principles and procedures for evaluating the toxicity of household substances. Washington, DC; National Academy of Sciences (1977).

Two general procedures have been recommended for use in the initial search for toxic behavioral effects of chemicals. One studies the circadian cycle of activity, the operant behavior. They are believed to be sensitive, quantitatively reliable, and relatively easy to perform. These features are important where several doses of a compound, and perhaps several different groups of animals varying in age, sex, strain, or species, may be needed for an adequate evaluation. In addition, both procedures are suitable for the evaluation of the onset rate of an effect during exposure and the rate and completeness of recovery when exposure ceases, both extremely important features of behavioral toxicity. Only relatively simple methods have been recommended for routine use. More elaborate and specific procedures should prove useful in elucidating the nature of any behavioral toxicity. Additional techniques, drawn from neurophysiology, neurocytology, and neurochemistry, would be required to explore fully the mechanisms of action of toxic chemicals. From a practical standpoint, the existence of behavioral toxicity at a particular exposure level is important in its own right, whatever the mechanisms of action. Behavioral toxicity may result from effects on a wide variety of organs and tissues. It is by no means an unequivocal indication of direct CNA toxicity. Behavioral toxicology is still in an early stage of development, with systematic experimental studies appearing only recently. No testing methods have been adequately validated through extensive use. a thorough reassessment of suggested procedures will be needed as more data become available.

19576 r- and K-selection in a completely chaotic population model. Felsenstein, J. (Univ. of Washington, Seattle). Contract AT(45-1) 2225 TA 5. *Am. Nat.;* **113**: No. 4, 499-510(Apr 1979).

A model of discrete-generations population dynamics originally due to M.H. Williamson is analyzed. In this model, the negative effect of population density acts suddenly and completely as the population size passes a threshold. The model almost always yields chaotic fluctuation of population size. When it does, this chaos ensues whatever the initial population size. The average population cycle length is found, as well as the distribution of population sizes over time. One can readily analyze r- and K-selection in this model. Natural selection will favor cycles with more time spent above the threshold population size, and will favor increase of the threshold. When r- and K-selection oppose each other, protected polymorphism is possible in an asexual or haploid population, but only if the genotype which would be lost if there were no K-selection has the greater population fluctuation when present alone. Conditions for protected polymorphism in a two-allele diploid population are also given.

19577 Movement disorders induced in monkeys by chronic haloperidol treatment. Weiss, B.; Santelli, S.; Lusink, G. (Univ. of Rochester, NY). *Psychopharmacology (Berlin);* **53**: 289-293(1977).

After several months of treatment, Cebus apella, Cebus albifrons, and Saimiri sciurea monkeys maintained on haloperidol, in doses of 0.5 or 1.0 mg/kg orally 5 days per week, began to display severe movement disorders, typically 1 to 6 h post-drug. Cebus monkeys exhibited violent, uncontrolled movements that flung the animals about the cage. Such episodes usually lasted only a few minutes, recurring several times during the period following drug ingestion. Writhing and bizarre postures dominated the response in S. sciurea. Cessation of drug treatment produced no distinctive after-effects. When tested as long as 508 days after the last administration, however, Cebus monkeys responded to haloperidol with several episodes of hyperkinesis, even at challenge doses considerably lower than those in the original treatment.

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 19583, 19584, 19587, 19589, 19650

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 19588

19578 (COO—2725-05) **Repair of DNA treated with γ-irradiation and chemical carcinogens. Progress report, March 15, 1979-March 15, 1980.** Goldthwait, D.A. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Biochemistry). 1980. Contract EY-76-S-02-2725. 5p. Dep. NTIS, PC A02/MF A01.

The identification and purification of 3-methyladenine glycosylase from the cell nuclei of rat liver was completed. The characterization of 7-methylguanine N-glycosylase activity in E. coli is currently under investigation. Alkylated DNA in chromatin structures as a substrate for 3-methyladenine N-glycosylase is discussed. An enzyme from E. coli and mammalian tissue active on 2,6-diamino-4-hydroxy-5-N-methyldormamido-pyrimide is isolated and characterized. Studies are proceeding on the correlation of x-ray sensitivity with removal of alkylated bases from DNA in x-ray sensitive and x-ray resistant lines of lymphoma cells. The reaction of β-propiolactone with derivatives of adenine and with DNA is discussed.

CYTOLOGY

19579 Method of freezing living cells and tissues with improved subsequent survival. Senkan, S.M.; Hirsch, G.P. (to Dept. of Energy). US Patent Application 967,748. 8 Dec 1978. 10p.

This invention relates to an improved method for freezing red blood cells, other living cells, or tissues with improved subsequent survival, wherein constant-volume freezing is utilized that results in significantly improved survival compared with constant-pressure freezing; optimization is atainable through the use of different vessel geometries, cooling baths and warming baths, and sample concentrations.

19580 Apparatus for measuring resistance change only in a cell analyzer and method for calibrating it. Hoffman, R.A. (to Dept. of Energy). US Patent Application 957,632. 3 Nov 1978. 6p.

The disclosure relates to resistance only monitoring and calibration in an electrical cell analyzer. Sample and sheath fluid flows of different salinities are utilized, the sample flow being diameter modulated to produce a selected pattern which is compared to the resistance measured across the flows.

19581 In vivo and in vitro studies of the evolution of epithelial neoplasia. Nettesheim, P.; Marchok, A.; Terzaghi, M. pp 307-329 of Polycyclic hydrocarbons and cancer. Volume 2. Washington, DC; Academic Press, Incorporated (1978).

The neoplastic process as it occurs in fully matured and organized epithelial organs and tissues is investigated in this chapter. Respiratory tract mucosa and preneoplastic lesions of the cervix uteri were studied. The studies demonstrated that carcinogen-exposed cells of various origins have one feature in common - a markedly increased capacity to survive and grow in vitro. This change appears very early - before the neoplastic cells appear. The process of carcinogenesis in vivo is characterized by a latent period between exposure to a carcinogen and the appearance of the neoplasm. The persistence of the carcinogen is not required for the later development of malignancy. The appearance of the tumor signals the presence of a cell population with destructive and unlimited growth capacity. The concept that initiated cells give rise to successive generations of preneoplastic cells which in turn give rise to neoplastic progeny is discussed.

GENETICS

19582 (COO—2121-67) **Cytogenetics of monosomes in Zea mays. Progress report, May 16, 1979-May 15, 1980.** Weber, D.F. (Illinois State Univ., Normal (USA)). Feb 1980. Contract EY-76-S-02-2121. 46p. Dep. NTIS, PC A03/MF A01.

Monosomics lack a pairing partner in each meiotic cell, and genes on an entire chromosome are present in the hemizygous condition. Monosomics for chromosomes 1, 2, 3, 4, 6, 7, 8, 9, and 10 in Zea mays have been isolated. This is the only series of this type that has been recovered in any diploid organism. The monosomic plants are vigorous, good cytological samples can be taken, and crosses can be made. All possible monosomic types are being isolated and characterized by studying: (1) the cytology of meiosis; (2) the cytological behavior of univalent chromosomes; (3) the effect of monosomy and trisomy on intergenic and intragenic recombination; (4) the frequency and types of spontaneous chromosomal aberrations arising in monosomics; (5) the effect of aneuploidy on the relative amounts of specific fatty acids in embryos; (6) monosomic mutational mapping; and (7) metabolic profile analysis of monosomics. Systems in maize to detect the environmental and genetic induction of nondisjunction are also being developed. By comparing a monosomic with its disomic siblings, one compares one and two copies of all genes on an entire chromosome. If a gene expressing dosage effects resides on a specific chromosome, a difference will be found between a plant monosomic for that chromosome and its diploid siblings.

Genetic factors that control the meiotic process, genetic recombination, lipid biosynthesis, and the free amino acid pool have been discovered.

METABOLISM

REFER ALSO TO CITATION(S) 19589

TRACER TECHNIQUES

19583 Uptake of methylamine (an ammonium analogue) by Macrocystis pyrifera (phaeophyta) . Wheeler, P.A. (California Inst. of Tech., Corona del Mar, CA). Contract E(04-3)-1275. *J. Phycol.;* **15**: No. 1, 12-17(Mar 1979).

The ammonium analogue, methylamine, is taken up rapidly from dilute solution by Macrocystis pyrifera (L.) C. A. Agardh. ^{14}C-methylamine was used to characterize the transport system, with respect to dependence on external concentration, temperature, pH and substrate specificity. The results suggest that methylamine enters the algal tissue via a specific mediated transport system. Uptake of methylamine showed no consistent relation to the N content of the plant tissue, but was highly dependent on the portion of plant sampled and severely affected by cutting the tissue. The strong inhibition of methylamine uptake by ammonium and lesser inhibition by other alkylamines suggests that the uptake system functions as an ammonium permease. Uptake of ^{14}C-methylamine can be used as a highly sensitive measure of NH_4^+ uptake activity and should be a useful tool for studying NH_4^+ uptake in the laboratory and field.

MEDICINE

REFER ALSO TO CITATION(S) 19579

19584 Enhancing effects of phenobarbitone and butylated hydroxytoluene on 2-acetylaminofluorene-induced hepatic tumorigenesis in the rat. Peraino, C.; Fry, R.J.M.; Staffeldt, E.; Christopher, J.P. (Argonne National Lab., IL). *Food Cosmet. Toxicol.;* **15**: 93-96(1977).

A comparison has been made between the enhancing effects of 0.05% dietary phenobarbitone and of 0.5% dietary butylated hydroxytoluene (BHT) on hepatic tumorigenesis in rats previously fed 2-acetylaminofluorene for a brief period. Prolonged feeding of the BHT diet produced a significant degree of enhancement which, however, was both lower in magnitude and delayed, in comparison with the enhancement produced by the phenobarbitone diet. Daily phenobarbitone injections stimulated persistent liver enlargement and a transient fourfold increase in DNA synthesis over a 5-day period. Similar treatment with BHT produced less pronounced liver enlargement after a delay of 1 day and did not stimulate DNA synthesis as did phenobarbitone. The results suggest that the dissimilar tumorigenic-enhancing abilities of BHT and phenobarbitone may result from differences in the effects of these agents on biochemical processes related to liver growth.

UNSEALED RADIONUCLIDES IN DIAGNOSTICS

REFER ALSO TO CITATION(S) 19197, 19260

19585 (CONF-791037—26) **CdTe ambulatory ventricular function monitor.** Lazewatsky, J.L.; Alpert, N.M.; Moore, R.H.; Boucher, C.A.; Strauss, H.W. (Massachusetts General Hospital, Boston (USA); Radiation Monitoring Devices, Inc., Watertown, MA (USA); Ohio Nuclear, Inc., Solon (USA)). 1979. Contract EY-76-C-02-2541. 5p. Dep. NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; San Francisco, CA, USA (17 Oct 1979).

A prototype device consisting of two arrays of CdTe detectors, ECG amplifiers and gate, microprocessor, and tape recorder was devised to record simultaneous ECG and radionuclide blood pool data from the left ventricle for extended periods during normal activity. The device is intended to record information concerning both normal and abnormal physiology of the heart and to permit the evaluation of new pharmaceuticals under everyday conditions. Preliminary results indicate that the device is capable of recording and reading out data from both phantoms and patients.

MICROBIOLOGY

REFER ALSO TO CITATION(S) 18446, 19625, 19627, 19629, 19630, 19631

19586 Anaerobic biodegradation of eleven aromatic compounds to methane. Healy, J.B. Jr.; Young, L.Y. (Stanford Univ., California). *Appl. Environ. Microbiol.;* **38**: No. 1, 84-89(Jul 1979).

A range of 11 simple aromatic lignin derivatives are biodegradable to methane and CO_2 under strict anaerobic conditions. A serum-bottle modification of the Hungate technique for growing anaerobes was used for methanogenic enrichments on vanillin, vanillic acid, ferulic acid, cinnamic acid, benzoic acid, catechol, protocatechuic acid, phenol, p-hydroxybenzoic acid, syringic acid, and syringaldehyde. Microbial populations acclimated to a particular aromatic substrate can be simultaneously acclimated to other selected aromatic substrates. Carbon balance measurements made on vanillic and ferulic acids indicate that the aromatic ring was cleaved and that the amount of methane produced from these substrates closely agrees with calculated stoichiometric values. These data suggest that more than half of the organic carbon of these aromatic compounds potentially can be converted to methane gas and that this type of methanogenic conversion of simple aromatics may not be uncommon.

19587 Substrate competition between a salt marsh diatom and a bacterial population. Saks, N.M.; Kahn, E.G. (City College, New York). Contract E(11-1)3254. *J. Phycol.;* **15**: No. 1, 17-21(Mar 1979).

Cylindrotheca closterium Ehrenberg, a benthic marine diatom, competes successfully with Acromonas sp. a bacterium from the same environment, for low molecular weight organic substrates when they are presented at natural concentrations (1 to 10 μM). In sort term (1 h) experiments, the uptake of mannose by C. closterium was enhanced in light. Seventy percent of the total uptake of mannose by both species was effected by C. closterium over a 1 h period in light. The diatom population was also competitive in darkness. The algal portion of glucose uptake over 1 h was 71% when both populations were given the substrate initially. Percentages of total amino acid uptake for C. closterium ranged from 33% glycine in light to 73% leucine in darkness when both species were given substrate initially. Cylindrotheca had smaller percentages of glucose and aspartic acid total uptake in competition experiments run to stationary phase (10 days).

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 19583, 19704

19588 Osmoregulation in themarine diatom Cylindrotheca fusiformis. Paul, J.S. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *J. Phycol.;* **15**: No. 3, 280-284(Sep 1979).

A mechanism for the regulation of internal osmolarity in the diatoms (Bacillariophyta) was investigated using the intertidal/estuarian pennate diatom, Cylindrotheca fusiformis Reimann and Lewin. The intracellular pools of the free sugar, mannose, and its respective polymer, polymannose, were found to be in a dynamic equilibrium which rapidly responds to changes in external osmotic pressure. Increasing the salinity shifts the steady state in the direction of free mannose, while decreasing the salinity stimulates polymerization of the free mannose to its polysaccharide. The mechanism requires a response of certain key enzymes to osmotic pressure rather than to levels of any particular ion since increasing the external osmolarity with an organic solute (sorbital) was as effective in eliciting a response as using inorganic ions.

MORPHOLOGY

REFER ALSO TO CITATION(S) 19662

PATHOLOGY

REFER ALSO TO CITATION(S) 19581

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 19683

19589 Electron probe microanalysis and the cellular basis of intestinal calcium absorption. Coleman, J.R. pp 25A-25E of Microbeam Analysis Society thirteenth annual conference. Ann Arbor, MI; Microbeam Analysis Society (1978).

From 13. annual conference of the Microbeam Analysis Society; Ann Arbor, MI, USA (19 Jun 1978).

The biochemistry of calcium metabolism and the mechanisms which maintain calcium concentrations at narrow limits in cells are investigated. The intracellular mechanism may involve the mitochondria in the overall maintenance of low concentrations. When relatively large influxes of calcium (such as occur in response to

hormones) raise the cytoplasmic level beyond that which can be handled by the plasma membrane pump, the mitochondria transport calcium into their matrix space thereby lowering the cytoplasmic calcium. This mechanism has been demonstrated in nerve and muscle cells. The microprobe analysis was performed on the cells involved in calcium absorption to determine whether this mechanism or another peculiar to transporting cells operates to maintain the constant low cytoplasmic calcium concentration. The results of studies on the chick chorioallantoic membranes and on the small intestines of the rat and chicken are reported.

19590 Oocyte growth in nonmammalian vertebrates. Wallace, R.A. (Oak Ridge National Lab., TN). pp 469-502 of Vertebrate ovary. Jones, R.E. (ed.). New York, NY; Plenum Publishing Corporation (1978).

The yolklike components present in the serum of xenopus laevis, the South African clawed toad, are studied in this chapter. A lipoglycophosphoprotein, vitellogenin, is secreted by the liver under estrogenic control and under the influence of gonadotropins. This protein is selectively taken up by growing oocytes and converted into yolk proteins. This overall process is detailed and comparative information on other vertebrates is presented.

PUBLIC HEALTH

REFER ALSO TO CITATION(S) 19719, 19720

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 18916, 18922, 19424, 19428, 19429, 19430, 19431, 19447, 19449, 19452, 19454, 19557

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS ON BIOCHEMICALS

19591 (DOE-tr—4/13) **Radiobiology.** Translation of *Radiobiologiya;* **19**: No. 1, 1-160(1979). 196p. NTIS $7.50.

Separate abstracts were prepared for each of the 33 articles presented in this issue of these translations. (ERB)

19592 (DOE-tr—4/12) **Radiobiology.** Translation of *Radiobiologiya;* **18**: No. 6, 803-943(1978). 180p. NTIS $7.50.

Separate abstracts were prepared for each of the 32 articles presented in this issue of these translations. (ERB)

IN VITRO

19593 (DOE-tr—4/14) **Radiobiology.** Translation of *Radiobiologiya;* **19**: No. 2, 163-316(Oct 1979). 193p. NTIS $7.50.

Separate abstracts were prepared for the 32 papers presented in this issue of the translations. (ERB)

19594 Reduced yield of x-ray-induced long-lived paramagnetic centers in melanin-containing wool. Latypov, I.F.; Vsevolodov, E.B.; Golichenkov, V.A. (Institute of Experimental Biology, Alma-Ata, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 32-37(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 189-193(1979).

After exposure to x rays in the air at 300°K in doses of 60 to 1000 krad, the absolute increment of free radicals (10^{16} spin/g) is several times lower in brown wool (containing melanin) than in pure white wool or white wool to which melanin powder, which is not dispersed in the wool fibers, is added (8.10^{16} spin/g).

19595 (DOE-tr—4/15) **Radiobiology.** Translation of *Radiobiologiya;* **19**: No. 3, 323-476(1979). 195p. NTIS $7.50.

Separate abstracts were prepared for the 34 papers presented in this translation. (ERB)

19596 Significance of reversible molecular changes during chronic exposure of biological objects to radiation. Kuzin, A.M.; Nazarova, L.F. (Institute of Biological Physics, Pushchino, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 99-101(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 885-887(1978).

Reversible changes in biological objects and fluids after exposure to gamma radiation were investigated. The possibility that physiological processes which are inseparably linked with diffusion, adsorption of molecules, and transport of ions and electrons on surfaces of macromolecules may change their constants and parameters by virtue of chronic irradiation was discussed. The rate of sorption-desorption of a substance in the course of its interaction with cellulose during chronic exposure to low doses of gamma radiation was also discussed.

19597 Effects of x- and ultraviolet radiation on egg albumin solutions. Buturlakin, M.S.; Bolycheva, E.V. (Voronezh State Univ., USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 107-110(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 891-894(1978).

The changes in amino acid radicals of tyrosine and tryptophan under the influence of different forms of radiation with change in medium pH were investigated. Acid and neutral egg albumin solutions were exposed to x radiation and ultraviolet radiation and the absorbed doses were determined. The changes in solvent perturbation absorption spectra were discussed.

IN PLANTS

19598 Investigation of repair of single DNA breaks in Vicia faba cells. Krupnova, G.F.; Seregina, T.B. (Institute of Cytology, Leningrad, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 111-114(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 894-897(1978).

The molecular nature of DNA repair in plant cells was investigated. The repair of single-strand DNA of horse bean seedling roots were evaluated according to the change in electrophoretic mobility of denatured DNA specimens in agarose-polyacrylamide gel. The inhibitory effects of caffeine administered after irradiation on repair of DNA were also discussed.

IN ANIMALS

REFER ALSO TO CITATION(S) 19650, 19660, 19671

19599 Biophysical model of effect of ionizing radiation on DNA. Obaturov, G.M. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 1-11(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 163-171(1979).

In this work, a biophysical model is offered for the formation of single- and double-stranded DNA breaks when live cells are exposed to ionizing radiation. The theory is based on the most elementary physical conceptions, which take into consideration the discrete nature of energy transmission when a charged particle passes through the DNA molecule. On the basis of this model and probability theory, formulas were obtained for the number of single- and double-stranded breaks as a function of radiation dose and quality. The theoretical curves conform satisfactorily with experimental data.

19600 Distinctions of DNA degradation in radiosensitive tissues exposed to nonuniform radiation. Golubentsev, D.A.; Gusev, I.V.; Il'inskii, D.A. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 112-116(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 257-260(1979).

The changes in the levels of polydeoxyribonucleotides in highly radiosensitive tissue after exposure to nonuniform radiation (irradiation of the anterior or posterior half of the body) were studied. The cells of the thymus and bone marrow were used. The contribution of direct and remote elements were evaluated in the overall radiation effect.

19601 Changes in adenosine triphosphatase activity of subcellular fractions of mouse liver and spleen under the influence of ionizing radiation. Ivashchenko, A.T.; Balmukhanov, S.B.; Bushneva, I.A. (Institute of Zoology, Alma-Ata, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 117-121(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 260-264(1979).

The influence of varying doses of x radiation on the activity of several ATP-ases in cellular fractions of the liver and spleen were studied. The radiosensitivity of these enzymes and the correlation between ATP-ase activity and its cellular functions were discussed.

19602 Acid phosphatase activity in canine tissues after exposure to gamma radiation at a low dose rate and preventive-therapeutic administration of adenosine triphosphate. Bicheikina, N.I.; Tikhomirova, M.V.; Romantsev, E.F.; Rogozkin, V.D. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 113-116(Oct 1979).

Translated from Radiobiologiya; 19: No. 1, 99-103(1979).

The radioprotective effects of ATP on the activity of acid phosphatase in dog blood and tissues were investigated. Low doses of gamma radiation of the whole body using a cesium 137 source were administered ATP was administered intramuscularly 15 minutes before irradiation or 15 to 20 minutes after irradiation. Free and total acid phosphatase activity was assayed.

19603 Effect of ionizing radiation on transfer of rapidly labeled nuclear RNA in an acellular system. Khanson, K.P.; Komar, V.E.;

Zhemkova, L.N.; Nesterova, S.M.; Porollo, V.I. (Central Scientific Research Inst. of Roentgenology and Radiology, Leningrad, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 122-125(Oct 1979).

Translated from Radiobiologiya; 19, No. 1, 108-110(1979).

The transfer of the rapidly labeled fraction of nuclear RNA in an acellular system derived from the livers of whole-body irradiated rats was investigated. The effect of potassium orotate on this system was also studied.

19604 Uridine kinase activity of rat tissue extracts after exposure to gamma radiation and preventive administration of mercaptoethylamine. Sviridenko, O.P.; Koshcheenko, N.N.; Romantsev, E.F. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 134-138(Oct 1979).

Translated from Radiobiologiya; 19, No. 1, 117-120(1979).

The effects of gamma radiation and β-mercapto-ethylamine (MEA) on uridine kinase I activity in the rat thymus, spleen, and liver were investigated. MEA does not prevent postradiation impairment of enzyme activity which indicates the complex biochemical mechanisms of radioprotective agents.

19605 Role of protein synthesis in postradiation degradation of DNP and DNA in rat thymocytes. Ivannik, B.P.; Golubeva, R.V.; Murzaev, V.I.; Ryabchenko, N.I. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 1-8(1978).

Translated from Radiobiologiya; 18: No.6, 803-809(1978).

A study was made of postradiation changes in molecular weight of single-stranded DNA (SDNA) in alkaline nuclear and cellular lysates, molecular weight of single- and double-stranded DNA contained in polydeoxyribonucleotides (PDN), DNAase I activity and number of pyknotic nuclei in thymocytes of rats exposed to 900 R radiation. Administration of cycloheximide (3 mg/kg), an inhibitor of protein synthesis, immediately after irradiation prevented any reduction of molecular weight of SDNA in alkaline nuclear lysates, caused a 3.7-fold decrease in yield of PDN and reduced by 3.3 times the number of pyknotic nuclei in rat thymocytes 3 h after radiation; it also prevented an increase in DNAase activity 4 h after exposure. It is concluded, on the basis of the obtained data, that processes of DNP and DNA degradation induced by activation of DNAase synthesis make a substantial contribution to interphase death of lymphoid cells.

19606 Correlation between changes in free and bound neutral DNAase and its inhibitor in the spleen of irradiated albino rats. Kerova, N.I.; Pukhova, G.G.; Chebotarev, E.E.; Getmantsev, A.V. (Inst. of Oncological Problems, Kiev, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 9-14(1978).

Translated from Radiobiologiya; 18: No.6, 810-814(1978).

A study was made of changes in neutral DNAase activity in the spleen of albino rats, of natural DNAase inhibitor and complex thereof in the course of acute radiation sickness induced by exposing animals to x-rays in doses of 450, 750, and 1100 R. Radiation increases inhibitor activity and enhances activity of the bound form of DNAase, which is indicative, apparently, of intensification of complex formation, and the effect is related to radiation dosage.

19607 Nuclease activity in rat tissues during long-term delivery of divided doses of radiation. Kisel'gof, E.I. *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 15-21(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 815-820(1978).

Exposure of rats to 50 R γ-radiation daily increases activity of acid DNAases per nuclear cell, acid and neutral RNAases in bone marrow, spleen and thymus, in the dose range of 250 to 2500 R. The possibility of development of such an enzymatic change as a result of adaptive synthesis of nucleases involved in catabolism and repair of nucleic acids is discussed.

19608 Effects of radioprotective agents on endogenous synthesis and degradation of DNA in nuclei and chromatin. Kravetskaya, T.P.; Bagiyan, G.A.; Belyakova, N.V.; Krutyakov, V.M. (Institute of Nuclear Physics, Leningrad, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 40-47(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 836-841(1978).

A study was made of the effects of some amino thiols and indolyl alkylamines on unprogrammed synthesis of DNA induced by exposure of chromatin or rat liver nuclei to γ-radiation, postradiation degradation of DNA in irradiated chromatin, as well as replicative DNA synthesis in nuclei of the regenerative rat liver. It was established that the protective agents lower by several times the rate of nuclease initiation of unprogrammed synthesis, but have virtually no effect on rate of DNA elongation. It is assumed that this action of protective agents lowers the probability of enzymatic formation of poorly repaired double-stranded DNA breaks. The rate of replicative DNA synthesis is lowered by the protective agents by 1.5 to 2 times.

19609 Radiation-induced impairment of biosynthesis of nuclear proteins in the rat liver and thymus. Domashenko, A.D.; Umanskii, S.R.; Tokarskaya, V.I. (Institute of Biophysics, Pushchino, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 95-98(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 882-885(1978).

Synthesis of nuclear proteins in the liver and thymus of rats after exposure to gamma radiation was investigated. Total nonhistone proteins, bound nonhistone proteins, histones, and free nuclear proteins were extracted and assayed 30 and 120 minutes after irradiation and compared with controls. Histones demonstrated a specific impairment of synthesis after radiation treatment in rats.

19610 Changes in levels of 11-hydroxycorticosteroids and activity of 11β-hydroxysteroid dehydrogenase in rats exposed to gamma and neutron radiation. Litskevich, L.A.; Dokshina, G.A.; Korobeinikova, A.I. (Tomsk State Univ., USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 102-106(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 887-890(1978).

The activity of 11β-hydroxysteroid dehydrogenase in thymus, spleen, mesenteric lymph nodes, liver, and blood after exposure to gamma and neutron radiation was assayed. The relative radiosensitivity of liver and lymphoid tissues in relation to the activity of this enzyme is discussed.

19611 NAD-pyrophosphorylase activity and NAD$^+$ content of thymus nuclei of irradiated rats. Smirnova, T.N.; Zhulanova, Z.I.; Romantsev, E.F. *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 115-118(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 897-899(1978).

The effects of gamma radiation on the NAD-pyrophosphorylase (NAD-PP) activity in isolated cell nuclei of the rat thymus 6 hours after irradiation were investigated. NAD-PP activity of nuclei was determined according to the rate of formation of NAD$^+$ during incubation of nuclei with nicotinamide mononucleotide and ATP.

RADIATION EFFECTS ON CELLS

EXTERNAL SOURCE

REFER ALSO TO CITATION(S) 19591, 19592, 19593, 19595, 19599

19612 (DOE/EV/03110—31) Cellular heredity in haploid cultures of somatic cells. Progress report, August 1978-September 1979. Freed, J.J. (Institute for Cancer Research, Philadelphia, PA (USA). Fox Chase Cancer Center). Oct 1979. Contract AC02-76EV03110. 12p. Dep. NTIS, PC A03/MF A01.

During the past year, studies were continued on the relation of ultraviolet mutagenesis to DNA repair in cultures of the haploid frog cell line ICR 2A. The method of irradiation of cells in suspension was improved by construction of an improved detector with major sensitivity to the 254 nm Hg resonance line, to give better estimates of actual exposure of the cells. Using this method, dose-response and dose-fractionation studies on irradiation of ouabain resistance were carried out. The uv induction of this phenotype in the ICR 2A cell line was found to be less than that necessary for adequate analysis of dose-response curves. Cell fusion experiments using frog and mouse cells revealed an enhancement of mutagenesis in the mouse parent that will be explored in further work.

19613 Microdosimetric analysis of formation of chromosomal dicentrics after in vitro gamma irradiation of lymphocytes from patients with genetic defects. Korotkov, E.V.; Ivanov, V.I.; Khandogina, E.K. (Moscow Physical Engineering Inst., USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 38-43(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 194-198(1979).

A correlation was demonstrated between the yield of radiation-induced exchanges and chromosome breaks, and dosage of ^{60}Co γ radiation in patients with a ring chromosome, translocation and Louis-Bar syndrome [ataxia telangiectasia]. Analysis, based on the microdosimetry conception, shows that the increased yield of exchanges in the case of patients with translocation corresponds to a reduction of mean inactivation dosage and decreased number of absorption events required for the formation in a cell of at least 1, 2 or 3 dicentrics. A higher yield of breaks is observed in the presence of Louis-Bar syndrome. The possible mechanisms of increased radiosensitivity are discussed.

19614 Radiosensitivity of precursor stromal cells of human bone marrow when exposed to radiation in vitro in bone and cell suspension, and the modifying effect of hypoxia. Zherbin, E.A.; Kolesnikova, A.I.; Konoplyannikov, A.G.; Khoptynskaya, S.K.; Ermakov, V.I. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 56-60(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 209-213(1979).

A study was made of radiosensitivity of human bone marrow cells that form fibroblast colonies in monolayer cultures (CFU/sub f/) after exposure thereof to ^{60}Co γ rays under different conditions: in pieces of extirpated bone and in a cell suspension. The dose-survival curves for CFU/sub f/ in both experimental variants differ

in median lethal dose D_0 for cells: D_0 constituted 89 rad for the cell suspension and 328 rad for pieces of bone. In the case of a suspension bubbled with argon, there is an increase in radioresistance of CFU/sub f/ (D_0 constitutes 162 rad), whereas replacement of the air atmosphere with argon does not affect sensitivity of CFU/sub f/ irradiated in bone. The demonstrated differences in radiosensitivity of CFU/sub f/ of human bone marrow, which were exposed to radiation in suspension and in pieces of bone, are apparently attributable to the difference in oxygen status of cells at the time of irradiation. For CFU/sub f/ the maximum value of the oxygen effect is 3.7.

19615 Analysis of age-related radiosensitivity of mice. Bogatyrev, A.V.; Timoshenko, S.I.; Nikanorova, N.G.; Sverdlov, A.G. (Institute of Nuclear Physics, Leningrad, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 74-78(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 225-228(1979).

To determine the mechanisms of age-related differences in radiosensitivity of mice, a study was made of sensitivity of bone marrow stem cells from animals of different ages exposed to radiation in vitro, postradiation restoration of peripheral blood leukocyte level and cellularity of bone marrow and spleen. It was demonstrated by the method of spleen colonies that there is the same vulnerability of bone marrow cells in mice of all age groups. The level of restoration of the pool of hemopoietic cells is considerably lower in neonate mice than in adult ones exposed to radiation in equally effective doses ($LD_{50\ 30}$).

19616 Modification by adrenolytic agents of radioprotective and postradiation effects of phenylephrine hydrochloride in experiments on cell cultures. Yartsev, E.I.; Kulinskii, V.I.; Novosel'tseva, S.D.; Yashunskii, V.G. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 79-86(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 229-235(1979).

In concentrations of 10^{-6}-10^{-5} M, mezaton [phenylephrine hydrochloride] has a distinct radioprotective and postradiation effect on cells in an SOC [cynomolgus monkey heart] culture. The radioprotective effect is manifested by an increase in dose (D_0) and extrapolation number (n), and the postradiation effect, by an increase only in n and D/sub q/. The β-adrenolytic agent anaprilin [inderal] enhances both effects of mezaton, while the α-adrenolytic agent, tropaphen eliminates both. This confirms the fact that the radioprotective action of adrenomimetics and modification thereof by adrenolytics can be expressed on the cellular level.

19617 Oxygen effect and adaptive reactions of cells. Report 6. Kinetics of respiration of cells cultured under varying oxygenation and differing in modified radiosensitivity. Voloshina, E.A.; Meshcherikova, V.V. (Oncological Research Center, Moscow, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 146-149(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 283-286(1979).

Long term exposure of Chinese hamster cell cultures to a shortage of oxygen was studied and respiration kinetics were determined. The degree of modification of cellular radiosensitivity in the presence of acute hypoxia was discussed.

19618 Radioprotective efficacy of synthetic porphyrins in experiments on cell cultures. Novosel'tseva, S.D.; Yartsev, E.I.; Kirillova, G.V.; Ponomarev, G.V. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 163-168(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 297-301(1979).

The effects of several synthetic and semisynthetic porphyrins on the stimulation of postradiation survival of cell cultures were studied. Asynchronous cultures of monkey heart cells were used in the investigation.

19619 Effect of inhibitors of cellular metabolism on postradiation repair and degradation of DNA in rat thymocytes. Ivannik, B.P.; Golubeva, R.V.; Proskuryakov, S.Ya.; Murzaev, V.I.; Ryabchenko, N.I. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 1-5(Oct 1979).

Translated from Radiobiologiya; 19: No. 1, 3-7(1979).

The viscosimetric method was used to determine the molecular weight of high polymer single-stranded DNA in alkaline nuclear lysates for the study of the effects of a number of inhibitors of synthesis of DNA (hydroxyurea), macroergic elements (2,4-dinitrophenol, EDTA) and DNAase (Na^+ citrate, Ca^{++} ions) on the process of repair and secondary post-radiation degradation of DNA of rat thymocytes exposed to radiation in a dosage of 3 kR.

19620 Quantitative description of the process of formation of chromosomal aberrations: a model of sticky ends. Report 1. Low level ionizing radiation. Korotkov, E.V.; Orekhov, A.V. (Inst. of Engineering Physics, Moscow, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 19-27(Oct 1979).

Translated from Radiobiologiya; 19: No. 1, 19-25(1979).

A quantitative analysis is made of the molecular mechanism of formation of dicentrics, and the dose function is calculated. There is discussion of the case of irradiation in low doses, when the yield of dicentrics is a linear function of dosage of γ-radiation. Some experimental data are submitted in support of formation of radiation-induced exchanges due to complementary interactions of DNA fragments. The possibility is discussed of determining RBE as a function of LET for the formation of dicentrics with exposure to low doses of radiation.

19621 Oxygen effect and adaptation reactions of cells. Report 4. Correlation between modifying effect of hypoxia and level of prior oxygenation of cells. Meshcherikova, V.V.; Vainson, A.A.; Yarmonenko, S.P. (Oncological Research Center, Moscow, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 40-46(Oct 1979).

Translated from Radiobiologiya; 19: No. 1, 36-41(1979).

A study was made of dependence of the radiomodifying effect of oxygen on level of prior cellular oxygenation. It was demonstrated that exposure of Chinese hamster cells for 24 h to moderate hypoxia, which itself does not provide protection, leads to attenuation of the protective effect of acute hypoxia produced for the duration of irradiation. The protective effect of hypoxic gas mixtures, lowering the pO_2 of culture medium to 2 to 4 mm Hg, is 1.4 times smaller for hypoxia-adapted cells than those cultured under normal oxygenation conditions. Attenuation of the radioprotective effect of hypoxic gas mixtures on cells cultured under conditions of chronic hypoxia is related primarily to significant decrease in intensity of oxygen uptake.

19622 Effects of ionizing radiation on mitochondrial suspensions in different metabolic states. Kozyreva, E.V.; Grozdov, S.P. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 83-90(Oct 1979).

Translated from Radiobiologiya; 19: No. 1, 74-80(1979).

Exposure of isolated rat liver mitochondria to radiation in doses of 500, 1000 and 2000 R, in the isolation medium on ice, led to dissociation of oxidative phosphorylation (OP) in them only with the dose of 2000 R and aging within 30 min. Total inhibition of OP and sharp decrease in SH group content of mitochondria was obtained with delivery of 1000 R in the incubation medium without oxidation substrate, in a Petri dish, at a temperature of +20°C.

19623 Effects of natural and synthetic acid polypeptides on normal and gamma-irradiated Chinese hamster cells. Medvedev, A.I.; Mantsygin, Yu.A.; Revina, G.I.; Veselova, V.A.; Kublik, L.N.; Kuzin, A.M. (Institute of Biological Physics, Pushchino, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 22-30(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 821-828(1978).

It was demonstrated that natural and synthetic acid polypeptides, in concentrations of 10^{-4} to 10^{-5} M, are capable of inducing chromosomal aberrations in Chinese hamster cells, as well as enhancing the effect of radiation on these cells, as determined by the survival rate. It is assumed that natural polycarboxyl-containing compounds are involved in spontaneous and radiation mutagenesis, altering chromatin lesions that occur in dividing cells spontaneously and under the influence of radiation.

19624 Cyclic nucleotides and radioresistance. Report 3. Effects of catecholamines and cyclonucleotides on radioresistance of bone marrow stem cells in vitro experiments. Kulinskii, V.I.; Lobytsev, K.S.; Krivenko, E.D. (Krasnoyarsk Medical Inst., USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 55-61(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 848-853(1978).

The radioprotective effects of physiological concentrations of catecholamines and N^6,$O^{2'}$-dibutyryl-cAMP were demonstrated on stem cells of mouse bone marrow in in vitro experiments. Nonacylated cyclic nucleotides (cAMP, cGMP) do not protect stem cells against radiation. The protein inhibitor of protein kinase eliminates completely the radioprotective action of dibutyryl-cAMP, which is indicative of the significance of the protein kinase mechanism in the demonstrated effect.

19625 Investigation of the role of endogenous serotonin in the mechanism of action of radioprotective agents. Report 3. Lack of correlation between altered radiosensitivity of cells and change in their endogenous serotonin content. Konstantinova, M.M.; Nekrasova, I.V.; Gusareva, E.V.; Dontsova, G.V. (Institute of Developmental Biology, Moscow, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 69-73(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 860-863(1978).

A study was made of the link between the radiomodifying activity of norepinephrine (NE), N-ethylmaleimide (NEM) and a combination of these agents, on the one hand, and level of endogenous serotonin in cells of Ehrlich's ascites carcinoma and E. coli B cells, on the other. There is no similarity of reactions of different cells or same direction of changes in radioresistance and endogenous serotonin content, either under the effects of these agents (NE, NEM) separately or with a combination of protective agent with an agent that eliminates its protective influence or prevents expression thereof (NEM), which warrants the conclusion that endogenous serotonin is not the only factor that determines the radioprotective

action of protective agents. At the same time, the possibility cannot be ruled out that it is involved in the chain of reactions required for expression of the radioprotective effect.

19626 Investigation of radiovulnerability of human hemopoietic cells, using the method of in vitro bone marrow organ cultures. Zherbin, E.A.; Kolesnikova, A.I.Y.; Konoplyannikov, A.G.; Khoptynskaya, S.I.; Zhukovskii, I.Ya.; Ermakov, V.I. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 74-80(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 864-869(1978).

A study was made of radiation inactivation of different cellular series of human bone marrow, in organ cultures for the first 4 days after exposure to γ-radiation, as a function of radiation dosage. Analysis of decrease in relative and absolute number of proliferative cells of the granulocyte class (promyelocytes and myelocytes), lymphocytes, as well as overall cellularity as a function of radiation dosage revealed that two components can be distinguished in each instance: radiosensitive and radioresistant. Mature granulocytes and macrophages were present in cultures of irradiated bone marrow in relatively larger number, and in some case in absolutely larger number, than in the nonirradiated control. Calculation was made of doses that reduce cellularity to one-half, as compared to the nonirradiated control (D_{50}) for quantitative description of the effect of radiation on different classes of human bone marrow cells. For promyelocytes and myelocytes, D_{50} constitutes 278 rad (relative) and 188 rad (absolute); for lymphocytes it is 339 rad (relative) and 250 rad (absolute number) and the figure is 388 rad for overall cellularity.

RADIATION EFFECTS ON MICROORGANISMS

BASIC STUDIES

REFER ALSO TO CITATION(S) 19591, 19592, 19593, 19595

19627 Induction of mutations in extracellular lambda phage by gamma radiation: effect of cysteamine and independence from repair functions of the host cell. Bresler, S.E.; Kalinin, V.L.; Kuznetsova, L.V.; Suslova, I.N. (Inst. of Nuclear Physics, Leningrad, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 28-39(Oct 1979).

Translated from Radiobiologiya; 19: No. 1, 26-35(1979).

A study was made of the lethal and mutagenic effects of ^{60}Co γ-rays on λ cI857 phage, when irradiated in nutrient broth in the absence and presence of 5.10^{-2} M cysteamine, using different repair-deficient E. coli mutants as hosts. It was found that cysteamine protection of extracellular phage from the lethal effect of γ-radiation is genetically determined, and that its effectiveness diminishes sharply with a change from a host of the wild type (DMF [dose modification factor] = 1.9) to repair-deficient rec A, lex A, pol A and uvr E mutants (DMF = 1.2 to 1.4). Induction of potentially postreplicative c mutations of phage is unrelated to repair mutations of the host cell, including the rec A and lex A mutations, which block cellular γ-mutagenesis. The hypothesis is expounded that induction of c mutations is related to γ-damaged DNA bases paired in error during vegetative replication of DNA. The presence of cysteamine does not affect the initial kinetics of γ-induced mutagenesis, but does increase the maximum incidence of c mutations.

19628 Combined effect of hyperthermia and high-density ionizing radiation on yeast cells. Petin, V.G.; Berdnikova, I.P. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 160-162(Oct 1979).

Translated from Radiobiologiya; 19, No. 1, 137-139(1979).

Yeast cells were submitted to hyperthermia either before or after irradiation. The patterns of postradiation recovery were investigated. The enhancement of radiosensitivity by hyperthermia was discussed.

19629 DNA repair in gamma- and ultraviolet-irradiated Escherichia coli cells treated with caffeine and acriflavine. Zhestyanikov, V.D.; Savel'eva, G.E. (Institute of Cytology, Leningrad, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 31-39(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 829-835(1978).

A study was made of postradiation effects of caffeine and acriflavine on survival and repair of DNA in E. coli cells exposed to γ- and uv rays. When added to the postradiation medium, caffeine and acriflavine lower the survival rate of γ-irradiated radioresistant strains B/r and B/sub S-1/γR, and ur-irradiated uv-resistant strain B/r, without appreciable effect on survival of γ- and uv-sensitive strains. Survival of the uv-irradiated B/sub s-1/ mutant in the presence of caffeine increased somewhat. Caffeine and acriflavine depress repair of γ-induced (slow repair) and uv-induced single-stranded DNA breaks in strain B/r in a growth medium. Acriflavine inhibits the recombination branch of postreplicative DNA repair in cells of strain B/sub S-1/γR, whereas caffeine does not affect this process.

19630 Role of endogenous substances in creating a background of enhanced radioresistance. Report 11. The nature of differences in radioresistance of yeast cells (experiments with different strains of Saccharomyces cerevisiae). Goncharenko, E.N.; Gorskaya, T.G.; Gudz', T.I.; Zolotareva, L.T.; Kovaleva, Z.I.; Peshkova, E.N. (Moscow State Univ., USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 119-122(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 900-902(1978).

The levels of endogenous radioprotective substances in various strains of radioresistant and radiosensitive yeast cells were discussed. Histamine, serotonin, superoxide dismutase activity, and lipid hydroperoxides levels in the yeast cells were determined.

19631 Radioresistance of cells of different E. coli strains and endogenous serotonin content thereof. Konstantinova, M.M.; Nekrasova, I.V.; Panaeva, S.V. (Institute of Developmental Biology, Moscow, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 131-132(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 908-910(1978).

The role of endogenous serotonin in the natural variation of radiosensitivity in 3 strains of E. coli which differ significantly in their radiosensitivity was studied. The positive correlation between radioresistance of different stages of mitosis and endogenous serotonin levels at these stages was discussed.

19632 Effect of DNA-injuring agents on B. stearothermophilus. Report 1. High resistance of B. stearothermophilus to N-nitroso-N-methylurea, ultraviolet and gamma radiation. Gainullina, S.M.; Gumanova, A.V.; Vinogradova, N.A.; Gaziev, A.I.; Gumanov, L.L. (Institute of Biological Physics, Pushchino, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 133-137(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 910-913(1978).

The effects of DNA-attacking agents on thermophilic microorganisms were investigated. Bacillus stearothermophilus were treated with N-nitroso-N-methylurea, ultraviolet radiation or gamma radiation. Survival curves were plotted.

19633 Effectiveness of inactivation of E. coli cells by fast and intermediate neutrons. Kapchigashev, S.P.; Sokolov, V.A.; Myasnik, M.N.; Morozov, I.I. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 166-169(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 935-938(1978).

The effects of fast neutrons, intermediate neutrons, and gamma radiation on Escherichia coli were investigated. Radiosensitivity of E. coli to neutrons as a function of LET was estimated.

RADIATION EFFECTS ON PLANTS

BASIC STUDIES

REFER ALSO TO CITATION(S) 19591, 19592, 19593, 19595

19634 (COO—2283-10) Response of a forest ecotone to ionizing radiation. Progress report, October 15, 1978-October 14, 1979. Murphy, P.G.; Sharitz, R.R. (Michigan State Univ., East Lansing (USA); Savannah River Ecology Lab., Aiken, SC (USA)). Jul 1979. Contract EY-76-S-02-2283. 15p. Dep. NTIS, PC A02/MF A01.

Compositional and structural characteristics of three forest types, including aspen dominated, maple-birch dominated, and an intervening ecotone, were studied before and after irradiation in northern Wisconsin. Irradiation occurred during the summer of 1972. As of the summer of 1978, establishment of tree seedlings at 10 m from the radiation source continued to be inhibited by the vigorous development of ground vegetation except, in part, in the aspen area where seedling density increased sharply relative to 1977 because of an influx of Acer rubrum. By 1974 many of the seedlings at 20 m had reached the sapling size-class. At the present time it appears that recolonization of the 10 m irradiated zone by the original tree flora will be a very slow process, largely because of a dense growth of Rubus sp. and other heliophytes. As of 1978 the recovery of leaf litter production appeared to be continuing in all three areas although the ratios of tree to shrub litter were still well below preirradiation levels at 10 m and slightly below at 20 m. In most respects, the ecotone has shown properties and responses to radiation intermediate to those observed in the aspen and maple-birch areas. The rate and compositional characteristics of succession in the ecotone relative to aspen and maple-birch forest types is presently under study. (DC)

19635 Modification of radiation lesions to chromosomes by floxuridine and thymidine at different stages of the cell cycle. Azatyan, R.A.; Avakyan, V.A.; Sarkisyan, M.M. (Institute of Experimental

Biology, Yerevan, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 26-31(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 184-188(1979).

The effect of x rays in a dosage of 300 R on cells of Crepis capillaris L. seedlings at the G_1, S and G_2 phases was modified with 5-fluoro-2-deoxyuridine (FUDR [floxuridine, 2'-deoxy-5-fluorouridine]), thymidine and a mixture of FUDR and thymidine. An unusual spectrum of chromosomal aberrations was demonstrated under the influence of FUDR, characterized by an increase in simple chromatid breaks and isochromatic breaks without rejoining, as well as radical reduction of exchanges. Under the influence of thymidine, there was a decrease in altered cells. There was particularly distinct manifestation of the protective effect of thymidine at the G_2 and S phases. Thymidine reduces the number of intrachromosomal and interchromosomal exchange aberrations. The combination of FUDR and thymidine does not have an appreciable influence on the cytogenetic effect of radiation, and does not affect the number of different types of aberrations induced by x rays.

19636 Changes in quantity and quality of protein in barley grain after exposure of seeds to gamma radiation. Khlebnyi, V.S.; Levin, V.I.; Bychkova, Z.N.; Erval'd, M.A. (Ryazan' Agricultural Inst., USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 132-136(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 272-275(1979).

The effects of gamma radiation on barley seeds irradiated prior to sowing on the quality and quantity of protein in harvested barley grain was investigated and the results discussed.

19637 Modification of deuteron damage to wheat seed endosperm. Lutsishina, E.G.; Mel'nichuk, Yu.P.; Kozina, G.Ya. (Institute of Plant Physiology, Kiev, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 169-174(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 301-306(1979).

The effect of storing irradiated seeds of wheat on caryopsis was studied. The effects on sprouting and plant viability from irradiated caryopses were discussed. The radioprotective effects of potassium iodide on deuteron action was demonstrated and radioprotective coefficients were estimated.

APPLICATIONS

19638 Influence of tomato sowing time on manifestation of radiostimulating effect. Maltseva, S. (Inst. of Genetics, Sofia, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 180-183(Oct 1979).

Translated from Radiobiologiya; 19, No. 1, 152-154(1979).

The effectiveness of radiostimulation of seeds is determined by a number of factors, one of which is the time seeds are sown after exposure to radiation. In this study the influence of the planting time factor, under the prevailing conditions in Bulgaria, on the intensity of manifestation of the stimulating effect on tomatoes, induced by exposure to low doses of cobalt-60 gamma rays was investigated.

19639 Effect of ^{60}Co gamma radiation on rooting of green cuttings of Michurinka roses. Zal'tsfas, A.A. (All-Union Scientific Research Inst. of Essential-Oil-Bearing Plants, Simferopol', USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 184-188(Oct 1979).

Translated from Radiobiologiya; 19, No. 1, 154-157(1979).

A dose-response study was conducted to determine the optimum doses of gamma radiation for stimulation of root formation in green cuttings of the Michurinka variety of roses. This variety has been extensively assigned to zones in the south of the USSR and have difficulty in taking root when other rooting stimulation methods are used.

RADIATION EFFECTS ON ANIMALS

MAN

REFER ALSO TO CITATION(S) 19613

19640 (KEK—78-7, pp 7-11) **Population dose equivalent due to accelerator operations at KEK.** Katoh, K. (National Lab. for High Energy Physics, Oho, I. (Japan)); Thomas, R.H. Jun 1978.

In Studies on current problems of radiation shielding in KEK.

Provided a high energy accelerator may be considered as a point source of radiation, the population dose equivalent, M, may be approximated with an equation given by Stephens et al. Appropriate values of the parameters for KEK (Japan High Energy Research Laboratory) are as follows: the distance of the site boundary from the accelerator $r_0 = 0.5$ km, attenuation length of neutrons in air is 0.85 km, and shielding factors that take into account the shielding provided by hills and buildings, $s_1 = s_2 = 1.0$. The population living around the laboratory has been estimated from census data, and the results are summarized in a table. As for sigma(i) in persons/km^2 in the equation for M, sigma(1) = 102, sigma(2) = 229, and sigma(3) = 340 are obtained from the table. If H_0 represents the dose equivalent at the site boundary, the value of M/Ho for KEK becomes 210 person rem/fence post rem, and it is intermediate between the high values of 1000 person rem/fence post rem obtained at LBL and FNAL and the low value of 54 person rem/fence post rem reported for BNL.

19641 (KEK—78-7) **Studies on current problems of radiation shielding in KEK.** Thomas, R.H.; Watanabe, N.; Hirayama, H.; Katoh, K. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jun 1978. 54p. Dep. NTIS (US Sales Only), PC A04/MF A01.

Separate abstracts were prepared for individual items.

19642 (ORNL/TM—7137) **Fourth Personnel Dosimetry Intercomparison Study.** Dickson, H.W. (Oak Ridge National Lab., TN (USA)). Feb 1980. Contract W-7405-ENG-26. 43p. Dep. NTIS, PC A03/MF A01.

The fourth Personnel Dosimetry Intercomparison Study was held at the Oak Ridge National Laboratory's Dosimetry Applications Research Facility during March 15-23, 1978. The Health Physics Research Reactor (HPRR) used unshielded, with a 12-cm-thick Lucite shield, a 20-cm-thick concrete shield, or a 5-cm-thick steel and 15-cm-thick concrete shield, and provided four neutron and gamma-ray spectra. Then the dose was calculated based on the HPRR neutron spectra and dose conversion factors which had been determined previously for the four spectra. The results of these personnel dosimetry intercomparison studies reveal that estimates of dose equivalent vary over a wide range. The standard deviation of the mean of participants data for gamma measurements was in the range of 29 to 43%; for neutrons it was 57 to 188%. (PCS)

19643 (ORNL/TM—7230) **Report of the task group on dose calculations to ICRP Committee 2, March 17-21, 1980.** Ford, M.R. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 14p. Dep. NTIS, PC A02/MF A01.

Publication is reported on annual limit on intake and derived air concentration for the 21 elements (187 radionuclides) reported at the last committee meeting. Computations of dosimetric data are completed for 31 elements (each including an average of 8 to 9 radioisotopes) having a half-life of 10 minutes or more. Computer drawn decay chains are furnished for each parent radionuclide. Problems arose with elements that concentrate in the gastrointestinal walls, the brain, the bone marrow and those that produce gases or vapors. A revised computer format was developed. (PCS)

19644 Nuclear worker and ionizing radiation. Gilbert, E.S.; Marks, S. (Batelle Pacific Northwest Lab., Richland, WA). EY-76-C-06-1830. *Am. Ind. Hyg. Assoc. J.;* **40**: No. 10, 916-919(Oct 1979).

The possibilities and range of radiation effects to personnel of the nuclear industry as reported by Bertell are critiqued by Gilbert and Marks along with a reply by the author to the critique are given. The critique/reply includes discussions of radioinduction of leukemia, neoplasms, and occupational diseases and general exposure and dose responses.

19645 Nuclear worker and ionizing radiation. Parkinson, W.W. Jr.; Fair, M.F. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Am. Ind. Hyg. Assoc. J.;* **40**: No. 10, 919-922(Oct 1979).

The possibilities and range of radiation effects to personnel of the nuclear industry as reported to Bertell are critiqued by Parkinson and Fair with a corresponding reply given by Bertell. This critique/reply includes discussions of radiation exposures, dose-response relationships, and possible effects of nuclear weapon technology.

19646 Influence of temperature as a modifying factor on the cytogenetic effect of radiation on human lymphocytes. Borodkin, P.A. (Institute of Biology, Syktyvkar, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 150-154(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 286-290(1979).

The influence of temperature on the radiobiological effects in lymphocytes was studied. The mitotic activity and cytogenetic response to x irradiation of human lymphocytes was discussed.

19647 Functional state of erythron during exposure to divided doses of radiation. Teterina, V.I. (Tomsk State Medical Inst., USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 117-121(Oct 1979).

Translated from Radiobiologiya; 19: No. 1, 103-107(1979).

The effects of chronic radiation on the functional state of erythrocytes and their bone marrow precursors were investigated in guinea pigs. The sequence of occurrence of quantitative and functional changes in these cells after chronic low doses of x radiation was discussed.

19648 Effects of different radioprotective agents on cyclic adenosine-3'-5'-monophosphate and DNA synthesis in the spleen. Vladimirov, V.G.; Golubentsev, D.A.; Gusev, I.V.; Libikova, N.I. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 130-133(Oct 1979).

Translated from Radiobiologiya; 19, No. 1, 114-116(1979).

The changes in cAMP content of radiosensitive tissues after administration of radioprotective substances was investigated in

mice. The effects of the radioprotective substances on DNA synthesis and the extent to which these changes are related to cAMP content are also discussed.

VERTEBRATES

REFER ALSO TO CITATION(S) 19591, 19592, 19593, 19595, 19599, 19600, 19601, 19605, 19606, 19607, 19624, 19712

19649 Late effects of whole brain irradiation within the therapeutic range. Caveness, W.F. (National Institutes of Health, Bethesda, MD (USA)); Carsten, A.L. (Brookhaven National Lab., Upton, NY (USA)). pp 221-239 of Date biological effects of ionizing radiation. Vol. 2. Vienna, Austria; International Atomic Energy Agency (1978).

From Symposium on late biological effects of ionizing radiation; Vienna, Austria (13 Mar 1978).

Whole brain exposure with supervoltage irradiation was carried out on three sets of Macaca mulatta. Two sets of 12 monkeys each, at puberty, received single and fractionated exposures respectively. One set of 21 monkeys in adulthood received a fractionated exposure. Exposure to 1000 rads in a single dose, at puberty, caused no late effects. Exposure to 1500 rads caused small areas of necrosis in the forebrain white matter at 26 weeks, but a much more extensive involvement at and beyond 52 weeks that included confluent areas of necrosis in gray and white matter. Brain loss resulted in ventricular dilatation. Gliomas appeared in two out of three monkeys at or beyond 52 weeks. Exposure to 2000 rads caused such a wide scatter of focal areas of necrosis, including those in the brain stem, that survival beyond 20-26 weeks was not possible. All showed enlarged ventricular systems. Whole brain exposure, 200 rads a day, five days a week, for a course of 4000 rads, at puberty, resulted in no delayed effects. An exposure to 6000 rads, in a six weeks course, caused small, less than 1 mm, widely scattered necrotic lesions with a predilection for the forebrain white matter but not excluding the central gray matter and brain stem, at 26 weeks. At 52 weeks, there was considerable mineralization of the lesions and widespread telangiectasia. In the developing lesions, multiple minute breaks in the blood brain barrier caused diffuse brain swelling, reflected by papilloedema. Whole brain exposure to 6000 rads in a six weeks course, in the adult, produced less effects than the same dose at puberty. The onset of the scattered necrotic lesions was later than expected, appearing in one out of three animals at 33 weeks, two out of three animals at 52 weeks, and two out of three at 104 weeks. The lesions at 104 weeks were predominantly mineralized, but were accompanied by a greater extent of telangiectasia than seen in the pubescent monkeys.

19650 Effect of radioprotective agents in the benzothiadiazole class on mitochondrial respiration and oxidative phosphorylation. Vladimirov, V.G.; Chigareva, N.G. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 12-17(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 172-176(1979).

In in vitro experiments on mouse liver mitochondria, it was demonstrated that the most effective radioprotective agents in the benzothiadiazole class diminish coupling of processes of respiration and oxidative phosphorylation. It was established that the probable products of conversion of the tested radioprotective agents are capable of shunting the respiratory chain and transferring electrons directly to oxygen.

19651 Nuclear protein and DNA content of myocardial myocytes during adaptation of the irradiated heart to an increased hemodynamic load. Stepanov, R.P. (Central Scientific Research Inst. of Roentgenology and Radiology, Leningrad, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 18-25(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 177-183(1979).

The enlargement of cardiomyocyte nuclei in rats following local exposure to γ radiation (2400 R) and in the presence of compensatory hypertrophy is related to accumulation of nuclear proteins, with prevalence of non-histone fractions. There is a decrease in number of polyploid nuclei after irradiation and an increase in number of small nuclei with reduced DNA and protein content (with an excess of histones). The combined effect of radiation and a hemodynamic load enhances these radiation effects and attenuates the nuclear changes that are inherent in development of hypertrophy.

19652 Differentiation and radiosensitivity of hemopoietic stem cells of hypokinetic mice. Shvets, V.N. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 44-49(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 199-203(1979).

It was established that there is a change in erythroid differentiation and CFU [colony-forming unit] radiosensitivity at the early stage of hypokinesia (3 days), when there is prevalence of the stress reaction. This effect is related to redistribution of T lymphocytes, the number of which increases in the bone marrow of hypokinetic mice. At the late stages of hypokinesia (30 days), when the changes in the body are attributable to hypokinesia, there is normalization of differentiation and radiosensitivity of CFU.

19653 Enhanced radioresistance of rat behavioral reactions after adaptation to hypoxia. Sizan, E.P. (Institute of Biomedical Problems, Moscow, USSR). *Radiobiology (USSR) (Engl. Transl.);* **T**: No. 2, 50-55(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 204-208(1979).

Rats were adapted to hypoxia in a pressure chamber which simulated an altitude of 5000 m with hourly ascents to peaks of up to 8000 m at climb and drop rates of 40 m/s. Adapted and intact animals were exposed to radiation in a dosage of 400 rad delivered at the rate of 20 rad/min. More significant improvements of conditioned reflexes was observed in rats after adaptation to hypoxia followed by irradiation, as compared to animals that were not adapted to hypoxia.

19654 Comparative evaluation of bone marrow hemopoiesis in the sternum and ilium of dogs after total-body nonuniform x irradiation. Kalandarova, M.P. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 61-67(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 214-219(1979).

It was demonstrated there is more marked damage to bone marrow of the iliac bone than sternum after delivery of radiation in doses of 300 and 500 R, with 5- and 8-fold differences in a dorsoventral direction. Conversely, there was more active and fuller repair regeneration in sternal bone marrow.

19655 Development of intestinal syndrome during three-day exposure of mice to radiation at different dose rates as a function of dosage. Koznova, L.B.; Lebedeva, G.A. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 68-73(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 220-224(1979).

A study was made of the conditions under which the intestinal syndrome develops and specifics thereof in the case of long-term irradiation on the model of 3-day irradiation of mice at dose rates of 0.3 to 0.9 R/min. In the dose range of 1300 to 3900 R, a comparison was made of data on mean survival time, cellularity of the small intestine, morphological signs of intestinal lesion and quantitative changes in the hemopoietic system. A comparison was made to the effects of short-term irradiation.

19656 Radioprotective properties of mercaptoacetamidines and possible biochemical mechanisms of action thereof. Bicheikina, N.I.; Zhulanova, Z.I.; Pushkareva, N.B.; Titov, B.A.; Romantsev, E.F.; Klimova, T.V.; Stanko, V.I.; Kovtun, V.Yu.;Yashunskii, V.G.; Krasheninnikova, E.A. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 87-93(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 235-240(1979).

A study was made of the radioprotective efficacy of some mercaptoacetamidines: 2-mercaptoacetamidine hydrochloride, bis-(2-acetamidino) disulfide dihydrochloride and N-(1-adamantylmethyl)-2-mercaptoacetamidine hydrochloride. It was demonstrated that all three compounds have a marked radioprotective action when administered intraperitoneally and by mouth. Data are submitted on the dynamics of distribution of ^{35}S-mercaptoacetamidine in organs and tissues of mice 5, 15, 30, 60 and 120 min after intraperitoneal administration. Evidently, an increase in protein SH groups in the spleen plays a substantial role in the mechanism of radioprotective action of mercaptoacetamidine.

19657 Effect of adenosine diphosphate against radiation delivered at high and low dose rates. Tikhomirova, M.V.; Rogozkin, V.D. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 94-99(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 241-245(1979).

Protective and therapeutic administration of ADP against radiation at a high dose rate (130 to 280 R/min) increased survival of purebred mice and guinea pigs by 50 to 70% and caused faster and better recovery of hemopoiesis. With reduction of dose rate to 1 R/min, the radioprotective action of ADP was less marked: survival increased by 40% for mice and 25% for guinea pigs.

19658 Change in mouse radiosensitivity under the influence of rotation. Arlashchenko, N.I.; Seraya, V.M.; Rodina, G.P. (Institute of Biomedical Problems, Moscow, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 105-111(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 251-256(1979).

The radiosensitivity of animals placed in a slowly rotating chamber changes under the influence of the functional load on the vestibular analyzer. There is an increase in radioresistance of populations of the most radiosensitive animals. In populations of more radioresistant animals, the gravitational load diminishes radioresistance.

19659 Stimulating effect of phytohemagglutinin on mitotic activity and RNA synthesis in mouse organs at the early postradiation term. Kuvshinov, N.N.; Dokshina, G.A. (Scientific Research Inst. of Biology and Biophysics at Tomsk Univ., USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 122-126(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 264-267(1979).

The use of phytohemagglutin (PHA) to stimulate biological recovery in mice after irradiation by x ray, gamma, or neutron sources was investigated.

19660 Effect of delivery of low divided doses of x-radiation on serotonin level and monoamine oxidase activity in the hypothalamus, insulin and corticosterone content of blood. Kandybo, T.S.; Dahskovskaya, O.P.; Dudina, T.V. (Institute of Physiology, Minsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 127-131(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 268-271(1979).

The effect of divided doses of x radiation on the state of neurohumoral regulation (seratonin of the hypothalamus, corticosterone, and insulin) which largely determines the nature of the body's reaction to radiation was investigated. To define the influence of the altered background of metabolic processes, animals were given intraperitoneal injections of glybutide and exposed to the same radiation regime. The results were compared and discussed.

19661 Investigation of intensity of ultraviolet fluorescence of leukocytes and bone marrow cells during chronic exposure to radiation. Barkan, R.S.; Safronova, V.G. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 137-139(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 275-278(1979).

The intensity of ultraviolet fluorescence of leukocytes and myelokaryocytes in rat blood was investigated for one year after discontinuing delivery of chronic radiation at varying dose rates. The results are discussed.

19662 Quantitative changes in different generations of erythroid and granulopoietic cells in rat bone marrow exposed to constant gamma radiation at different dose rates. Zukhbaya, T.M. (Institute of Biomedical Problems, Moscow, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 140-145(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 278-282(1979).

The quantitative changes in morphological parameters of bone marrow cells resulting from constant exposure to gamma radiation at varying doses are discussed.

19663 Role of thymus cells in splenic colony formation. Report 2. Redistribution of colony-forming cells in the body under the influence of concanavalin A. Semina, O.V.; Semenets, T.N.; Poverennyi, A.M. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 155-158(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 290-293(1979).

The effect of concanavalin A on processes of colony formation in the spleen of mice when administered at varying times after x irradiation was investigated. The alteration of processes of circulation and redistribution of CFUs in the body due to the influence of concanavalin A on thymus cells was discussed.

19664 Evaluation of radioprotective efficacy of some aminoalkylthiophosphoric derivatives. Report 1. Investigation of radioprotective efficacy of S-[N-(5-aminopentyl)-2-aminoethyl] thiophosphoric acid. Sverdlov, A.G.; Bogatyrev, A.V.; Nikanorova, N.G.; Timoshenko, S.I.; Kalmykova, G.I. (Institute of Nuclear Physics, Leningrad, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 159-162(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 293-296(1979).

The radioprotective effects of S-[N-(5 aminopentyl)-2-aminoethyl] thiophosphoric acid in mice exposed to x rays and neutrons were investigated. Survival curves and dose effects were discussed.

19665 Ubiquinone-9 regulation of cholesterol metabolism in the liver under normal conditions and in the presence of radiation lesion. Kolomiitseva, I.K.; Novoselova, E.G.; Nurullaeva, G.E.; Samokhvalov, G.I.; Obol'nikova, E.A.; Kuzin, A.M. (Inst. of Biological Physics, Pushchino, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 6-12(Oct 1979).

Translated from Radiobiologiya; 19: No. 1, 8-13(1979).

A load of ubiquinone-9 given by hypodermic injection for 2 days in a dosage of 200 mg/kg lowers liver cholesterol content in rats. There is also a decrease in cholesterol esters. The intensity of cholesterol biosynthesis, measured according to uptake of 2-^{14}C-acetate, is depressed to one-third to one-fifth. Administration of ubiquinone to γ-irradiated rats (dosage 800 R, 48 h after exposure) depresses to one-third to one-fifth radiation-activated biosynthesis of cholesterol. There is no decrease in levels of cholesterol esters, which were lowered by radiation, in the presence of a ubiquinone load in irradiated rats. The results are indicative of independent routes of regulation of 3-Hydroxy-3-methylglutaryl-coA reductase in the liver in the case of exposure to γ-radiation and a ubiquinone-9 load.

19666 Effect of radiation on activity of enzymes of pyrimidine nucleoside phosphorolysis in rat organs. Mikhailov, V.F. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 13-18(Oct 1979).

Translated from Radiobiologiya; 19: No. 1, 14-18(1979).

There is increased phosphorolytic breakdown of deoxyribosides, which is catalyzed by nuclear uridine phosphorylase 18 h after exposing rats to γ-radiation in doses of 500 and 700 R. There was no change in activity of cytoplasmic uridine phosphorylase after irradiation, while cytoplasmic thymidine phosphorylase activity was depressed. In vitro experiments demonstrated that, with change in concentration from 10^{-7} to 10^{-5} M, cAMP increased activity of thymidine phosphorylase and did not affect catalytic properties of cytoplasmic uridine phosphorylase in either control or irradiated animals.

19667 Incorporation of ^{3}H-thymidine in DNA of radiosensitive organs of rats exposed to radiation at high altitude and after adaptation to hypoxia in a pressure chamber. Guseinov, F.T.; Egorov, I.A.; Gladilin, K.L.; Farber, Yu.V. (Inst. of Biochemistry, Moscow, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 47-53(Oct 1979).

Translated from Radiobiologiya; 19: No. 1, 42-47(1979).

Preacclimatization of rats to high altitude conditions at 3200 m and conditioning in a pressure chamber at the same simulated altitude depresses incorporation of ^{3}H-thymidine in thymus DNA at both the early (after 26 h) and later (20 and 30 days) postradiation stages. The direction of the effect on the spleen and bone marrow of these animals depends on pretreatment conditions. The obtained findings are discussed from the standpoint of possible radioprotective effect of conditioning animals to altitude hypoxia.

19668 Radiosensitivity of hemopoietic stem cells cloned in bone marrow and spleen. Shvets, V.N.; Shafirkin, A.V. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 54-61(Oct 1979).

Translated from Radiobiologiya; 19: No. 1, 48-54(1979).

It has been demonstrated that the population of mouse bone marrow stem cells is heterogeneous with regard to radiosensitivity. The survival of about 55% CFU [colony-forming units] is described as an exponential function of radiation dose (D_0 = 9 rad). The dose-effect curve for the resistant part of the population (D_0 = 180 rad) is sigmoidal, with D/sub q/ = 130 rad. It is assumed that radiosensitive CFU represent the primary committed fraction of semistem cells, while the radioresistant ones are referable to the pool of pluripotent stem cells. The heterogeneity of the CFU population is confirmed with the use of various modifications of irradiation and in interaction of CFU with T lymphocytes.

19669 Mechanism of bone marrow lymphoid reaction in irradiated rats during period of restoration of hemopoiesis. Gol'dberg, E.D.; Karpova, G.V. (Tomsk State Medical Inst., USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 62-67(Oct 1979).

Translated from Radiobiologiya; 19: No. 1, 55-59(1979).

In experiments on rats exposed to radiation in a dosage of 600 rad, it was demonstrated that there is an increase in lymphoid element content during the period of regeneration of hemopoiesis (10th to 15th day) in bone marrow. The dynamics of morphological changes cytometry results, studies of proliferative activity, capacity for uptake of ^{3}H-thymidine and hydrolytic enzyme levels in lymphoid cells of bone marrow, thymus, spleen and lymph nodes, as well as experiments conducted on thymectomized and splenectomized animals, indicate that there is proliferation and maturation of lymphocytes in bone marrow at this time.

19670 Effect of radiation on structural and functional state of the pancreas and some of its hydrolases. Surinov, B.P.; Sheyanov, G.G. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 68-75(Oct 1979).

Translated from Radiobiologiya; 19: No. 1, 60-66(1979).

A comparison was made of changes in activity of multiple forms of esterases, acid phosphatase and structural and functional state of the rat pancreas after exposure to different doses of γ-radiation. With delivery of superlethal doses, a correlation was demonstrated between disturbances in tissue-specificity of enzyme composition and damage to cells of endocrine tissue, as well as repair thereof from acinar cells of the gland.

19671 Effects of cysteine, glutathione and 1-p-chlorophenyltetrazole-thione-2 on postradiation changes in metabolic free radical content of albino rat tissues. Fedorchenko, V.I.; Kulyabko, O.N.; Chebotarev, E.E. (Inst. of Oncological Problems, Kiev, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 76-82(Oct 1979).

Translated from Radiobiologiya; 19: No. 1, 67-73(1979).

Kinetic assays were made of metabolic free radicals in tissues of albino rats exposed to x rays and fast neutrons in doses of LD/sub 50/30/ and LD/sub 100/30/; studies were also made of the effects on this index of cysteine, reduced glutathione and 1-p-chlorophenyltetrazole-thione-2. Irradiation of the animals leads to a decline in concentration of metabolic free radicals, which is indicative of depression of processes of energy production in cells of the organism. Exposure to fast neutrons lowers the concentration of free radicals to a greater extent that exposure to x rays in an equally effective dose with regard to animal survival. It was demonstrated that cysteine, glutathione and 1-p-chlorophenyltetrazole-thione-2

have a radioprotective effect, which is more marked in the case of x rays.

19672 Spermatogenesis in dogs after discontinuing chronic exposure to gamma radiation for three years. Fedorova, N.L.; Markelov, B.A. (Inst. of Biomedical Problems, Moscow, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 91-96(Oct 1979).

Translated from Radiobiologiya; 19: No. 1, 81-85(1979).

A study was made of spermatogenesis in 15 dogs after discontinuing 3-year exposure to γ-radiation at a dose rate of 0.34 rad/day and 0.17 rad/day + 3 annual dose loads of 8 and 42 rad (cumulative doses of 375, 360 and 570 rad). Partial restoration of spermatogenesis was demonstrated. At the first stage (1 to 1.5 years) normalization was very intensive in dogs submitted to the maximum damage (cumulative dose 570 rad). Thereafter (3d to 6th years), there was slowing of recovery rate and the process of spermatogenesis became stabilized at a low level. There was less intensive recovery of dogs exposed to cumulative doses of 375 and 360 rad.

19673 Effects of shielding abdominal or head region on functional state of the rat gastrointestinal tract at the early stages of radiation sickness. Gavrilyuk, D.N.; Razgovorov, B.L. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 97-102(Oct 1979).

Translated from Radiobiologiya; 19: No. 1, 86-90(1979).

The effects of shielding the head or abdomen on functional state of the GI [gastrointestinal] tract during the first 3 days after exposure to γ-radiation were studied in experiments on albino rats. Local shielding of the head or abdomen lowered equally the degree of functional gastric disorders at the early (up to 24 h) postradiation stage. Thereafter, the protective effect of shielding the head diminished, whereas shielding of the abdomen, on the contrary, enhanced normalization of impaired GI functions. An evaluation was made of the contribution of central and peripheral mechanisms to early disturbances of radiation-induced GI functions.

19674 Effects of hydrocortisone and insulin on oxidative phosphorylation in liver and spleen mitochondria of rats exposed to fast neutrons. Sutkovoi, D.A.; Alferov, A.N.; Letov, V.N. (Scientific Research Inst. of Roentgenoradiology and Oncology, Kiev, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 126-129(Oct 1979).

Translated from Radiobiologiya; 19, No. 1, 111-113(1979).

The radioprotective effects of hydrocortisone and insulin on postradiation disturbances of energy metabolism in rats was investigated. The effects of neutron radiation on oxidative phosphorylation in mitochondria of the liver and spleen as well as the response modifying effects of hydrocortisone and insulin were discussed.

19675 Dynamics of ascorbic acid and riboflavin levels in the adrenals in the presence of radiation sickness, as related to different amounts of protein in the diet. Egorova, N.D. (First Moscow Medical Inst., USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 139-142(Oct 1979).

Translated from Radiobiologiya; 19, No. 1, 120-123(1979).

The influence of dietary protein on radiosensitivity was discussed. The metabolism of riboflavin and ascorbic acid in the adrenal glands of irradiated rats on diets of varying quantities and qualities of animal protein was investigated.

19676 Autoradiographic indices of early changes in reproductive and functional activity of cells in the anterior lobe of the rat pituitary after exposure to neutron radiation. Silina, A.G. (Inst. of Nuclear Physics, Leningrad, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 143-148(Oct 1979).

Translated from Radiobiologiya; 19, No. 1, 124-128(1979).

The morphological and functional changes in the anterior lobe of the pituitary of rats on the first day after total-body exposure to fast neutrons were investigated. Tritiated thymidine, used for autoradiography, and tritiated leucine, used for the study of protein synthesis, were administered 90 minutes prior to sacrifice. Animals were sacrificed 3, 6, 12, 18 or 24 hours after irradiation for the study.

19677 Investigation of hemopoietic system reactions to hemorrhage during acute and protracted exposure to radiation. Vershinina, S.F. (Central Scientific Research Inst. of Roentgenology and Radiology, Leningrad, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 149-151(Oct 1979).

Translated from Radiobiologiya; 19, No. 1, 128-130(1979).

The reactions of the hemopoietic system to loss of blood during acute and chronic exposure to radiation were studied. Slower reaction of the myelokaryocytes to loss of blood in chronically irradiated rats was observed as well as slower restoration of initial erythrocyte and hemoglobin levels. The adaptive capabilities of this system are diminished by chronic irradiation and are absent in the case of acute irradiation.

19678 Changes in the hemopoietic system of dogs exposed to acute, nonuniform x radiation and combination thereof with divided doses of radiation. Kalandarova, M.P.; Grammatikati, V.S.; Shafirkin, A.V. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 152-159(Oct 1979).

Translated from Radiobiologiya; 19, No. 1, 130-137(1979).

The dynamics of changes of the blood and bone marrow of dogs following whole-body irradiation with nonuniform distribution of doses were investigated. The mechanisms of damage and recovery of hemopoiesis that are required to establish the severity and prognosis of radiation damage to the body were also investigated. Dynamic studies of the blood and bone marrow were performed for 3 months after exposure.

19679 Radiosensitivity of endogenous colony-forming function in intact and irradiated mice. Butomo, N.V.; Pegov, A.A. (Military Medical Academy, Leningrad, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 163-166(Oct 1979).

Translated from Radiobiologiya; 19, No. 1, 140-142(1979).

The number of endogenous spleen colonies after repeated irradiation of mice with sublethal doses of gamma radiation was investigated. The dynamics of changes as a function of time in systemic radiosensitivity were compared.

19680 Possible use of combinations of radioprotective agents administered by mouth and inhalation. Solov'ev, Yu.A.; Zherebchenko, P.G. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 167-170(Oct 1979).

Translated from Radiobiologiya; 19, No. 1, 143-145(1979).

The possibility of summation of effects of radioprotective agents given via mouth and inhalation was investigated. The study was conducted on female mice exposed to total-body gamma radiation. Aminopropylaminoethylthiophosphate given by mouth and S-ethylisothiuronium given by inhalation were the radioprotective agents used.

19681 Oxygen effect and adaptation reactions of cells. Report 5. Limited use of Eh and pO_2 as quantitative indicators of modification of radiosensitivity. Kortukova, V.M. (Oncological Research Center, Moscow, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 171-175(Oct 1979).

Translated from Radiobiologiya; 19, No. 1, 145-148(1979).

In this work a quantitative analysis of tissue oxygen tension and redox potential, Eh, in relation to radiosensitivity modified by gas hypoxia and certain pharmacological agents was conducted. Male mice were exposed to total-body gamma radiation for the experiments. Oxygen tension was determined in subcutaneous tissue, bone marrow, and spleen by the polarographic method. Eh was measured by the electrometry method in subcutaneous tissue using standard methods with platinum electrodes. The radioprotective agents used were 2,3-aminopropylaminoethylthiophosphate and guanylthiourea.

19682 Investigation of radioprotective effect of a hypoxic gas mixture in experiments on monkeys. Strelkov, R.B.; Dikovenko, E.A.; Chizhov, A.Ya.; Ronin, M.Ya.; Bykov, N.O. (Brain Inst., Moscow, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 176-179(Oct 1979).

Translated from Radiobiologiya; 19, No. 1, 149-151(1979).

There is a significant number of studies demonstrating that production of hypoxic hypoxia in the body leads to a reliable protection of animals against the effects of ionizing radiation. However, most authors use an uncompensated form of hypoxia, which induces severe oxygen deficiency and death of some animals before irradiation, as the radiomodifying factor. In this study the radioprotective properties of breathing a 10% oxygen and 90% nitrogen gas mixture, a well-tolerated hypoxic gas mixture, by primates exposed to total-body radiation from a cobalt 60 gamma source.

19683 Oogenesis, follicular development and reproductive performance in the prenatally irradiated bovine. Erickson, B.H.; Reynolds, R.A. (Comparative Animal Research Lab., Oak Ridge, TN (USA)). pp 199-205 of Date biological effects of ionizing radiation. Vol. 2. Vienna, Austria; International Atomic Energy Agency (1978).

From Symposium on late biological effects of ionizing radiation; Vienna, Austria (13 Mar 1978).

To determine the radioresponse of the various developmental stages of the prenatal bovine germ cell, cows bearing foetuses varying in age from 40+-5 (point of gonadal sex differentiation) to 270+-10 (approximately 13 days before parturition) days of gestation were irradiated with 300 R of ^{60}Co gamma radiation at 25-50 R/min, a level just below that likely to cause maternal deaths and gross foetal abnormalities at some developmental stages. Dose to the foetal gonad was approximately 100 rad. When the prenatally irradiated heifers were approximately 10 months old their ovaries were recovered at slaughter, serially sectioned, and prepared for microscopic analysis. A complete quantitative analysis of oocytes in primordial, growing and vesicular follicles was effected. Follicular development (reflected by counts of growing and vesicular follicles) was apparently unaffected at all ages tested ($P>0.25$), whereas oogenesis (reflected by counts of oocytes in primordial follicles) was significantly impeded (64% of control) only between 70 and 90 days of gestation ($P<0.05$). The germ-cell population at this period differs

from later developmental stages principally by the presence of a high proportion of mitotically active oogonia, hence it appears that the oogonium is the most vulnerable cell type. Neither the viability nor reproductive performance of 60 cows that were prenatally irradiated (100 rad) at either 80+-10 or 130+-20 days of gestation was affected through a minimum of 5 years of postnatal life and three pregnancies.

19684 Relationship of dose rate and total dose to responses of continuously irradiated beagles. Fritz, T.E.; Norris, W.P.; Tolle, D.V.; Seed, T.M.; Poole, C.M.; Lombard, L.S.; Doyle, D.E. (Argonne National Lab., IL (USA)). pp 71-82 of Date biological effects of ionizing radiation. Vol. 2. Vienna, Austria; International Atomic Energy Agency (1978).

From Symposium on late biological effects of ionizing radiation; Vienna, Austria (13 Mar 1978).

Young-adult beagles were exposed continuously (22 hours/day) to ^{60}Co gamma rays in a specially constructed facility. The exposure rates were 5, 19, 17 or 35 R/day, and the exposures were terminated at 600, 1400, 2000 or 4000 R. A total of 354 dogs were irradiated; 221 are still alive as long-term survivors, some after more than 2000 days. The data on survival of these dogs, coupled with data from similar preliminary experiments, allow an estimate of the LD_{50} for gamma-ray exposures given at a number of exposure rates. They also allow comparison of the relativeimportance of dose rate and total dose, and the interaction of these two variables, in the early and late effects after protracted irradiation. The LD_{50} for the beagle increases from 344 R (258 rads) delivered at 15 R/minute to approximately 4000 R (approximately 3000 rads) at 10 R/day. Over this entire range, the LD_{50} is dependent upon haematopoietic damage. At 5 R/day and less, no definitive LD_{50} can be determined; there is nearly normal continued haematopoietic function, survival is prolonged, and the dogs manifest varied individual responses in the organ systems. Although the experiment is not complete, interim data allow serveral important conclusions. Terminated exposures, while not as effective as irradiation continued until death, can produce myelogenous leukaemia at the same exposure rate, 10 R/day. More importantly, at the same total accumulated dose, lower exposure rates appear more damaging than higher rates on the basis of the rate and degree of haematological recovery that occurs after termination of irradiation. Thus, the rate of haematologic depression, the nadir of the depression and the rate of recovery are dependent upon exposure rate; the latter is inversely related and the first two are directly related to exposure rate.

19685 Analytical approaches to and interpretations of data on time, rate and cause of death of mice exposed to external gamma irradiation. Grahn, D.; Sacher, G.A.; Lea, R.A.; Fry, R.J.M.; Rust, J.H. (Argonne National Lab., IL (USA)). pp 43-58 of Date biological effects of ionizing radiation. Vol. 2. Vienna, Austria; International Atomic Energy Agency (1978).

From Symposium on late biological effects of ionizing radiation; Vienna, Austria (13 Mar 1978).

Young adult male and female mice of inbred strains, A, BALB/c, C57BL/6 and C57L, and B6CF$_1$ and F$_2$ hybrids were exposed to daily duration-of-life external ^{60}Co gamma irradiation. Age at death was recorded, and most of the decreased were necropsied to ascertain occurrence of major types of tumours. Age- and cause-specific mortality or incidence rates were derived, and their regressions on age were fitted with polynomial equations by least-squares procedures. Age-specific and age-adjusted integrated lifetime risk in excess of the control population was expressed as the mortality ratio (irradiated/control). Linear and nonlinear functions and widely different life expectancies can be accomodated by this technique. These basic actuarial statistics provide a means for comparative analysis of dose-response functions, sex and genetic variables, relative versus absolute risk, protraction or dose-rate and major contributing causes of excess risk. They also provide a basis for extrapolation to man. As examples, life shortening in days per rads (4 days/100 rads accumulated) is generally independent of sex, genotype and daily dose rate. The integrated average lifetime risk of death related to all tumours (0.025%/rad) is largely indepenent of sex, genotype and dose-rates <12 rads/day, despite the fact that tumour incidence varies by a factor of 2 to 3 among genotypes. At low exposure rates, tumour-related mortality accounts for 80% of the excess risk, and life shortenening is a function only of accumulated dose, independent of dose rate below 12 rads/day. The radiobiological effectiveness for low daily exposure levels is less than that for single exposures by a factor of 5 to 10. Life shortening following low daily exposure rates is included at the rate of 0.03-0.06 days/R for the mouse, which extrapolates to about 1-2 days/R for man.

19686 Radioprotective properties of etioporphyrin-1 derivatives in gamma-irradiated mice. Tuzhilkova, T.N.; Puchkova, S.M.; Goloshchapova, Zh.A.; Malkina, R.M.; Kirillova, G.V.; Yashunskii, V.G.; Ponomarev, G.V. *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 48-54(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 842-847(1978).

The radioprotective properties of eight derivatives of etioporphyrin-1 were studied on C57B1/6 mice. It was demonstrated that mesodimethyl-aminoethyl-etioporphyrin-1 has a wide range of radioprotective action and prolonged effect when given preventively. Results are submitted on the modifying effect of this compound on survival of mice exposed to acute γ-radiation (900 R), kinetics of postradiation changes in bone marrow, permeability of cell membranes, mitotic activity of intestinal epithelial cells and protein synthesis.

19687 Thymocyte-induced modification of radiation changes in the pool of hemopoietic stem cells. Shvets, V.N. *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 62-68(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 854-859(1978).

Erythropoietic potential of CFU is enhanced, there is a change in slope and parameters of D_0 and n of the dose-effect curve when T lymphocytes interact with irradiated bone marrow cells. It was established by the spleen colony test that D_0 for DFU equals 111 to 122 R. At the same time, according to the bone marrow colony test, D_0 constitutes 157 to 197 R. When thymocytes are added to a transfusate of irradiated bone marrow, there is a change in parameters D_0 and n: D_0 constitutes 135 to 145 R according to the spleen colony test and 100 R, according to the bone marrow colony test.

19688 Submicroscopic reactions to long-term chronic gamma-radiation of tissues varying in radiosensitivity. Bespalova, L.A.; Shikhodyrov, V.V.; Romanov, V.S. *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 81-86(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 870-874(1978).

Analysis is made of the results of an electron microscope study of the myocardium, liver, lymph nodes and spleen of dogs exposed to chronic radiation for 6 years from a ^{60}Co source, in doses of 21, 62.5, and 125 rad/year. The possible mechanisms of biological effects of low doses on the subcellular level are discussed comprehensively on the example of tissues varying in radiosensitivity.

19689 Fatty acid levels and phospholipase activity in erythrocytes in the presence of radiation sickness with prior administration of cystamine. Serebrennikova, I.A. (Tomsk State Medical Inst., USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 123-126(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 903-905(1978).

The levels of free fatty acids and phospholipase activity in rabbit erythrocytes at various stages in the development of radiation injury were investigated. The effect of pretreatment with intravenous injection of cystamine on these indices was also discussed.

19690 Investigation of effects of 2-ADT (2-amino-5,6-dihydro-4H-1,3-thiazine) on hemopoietic organ reaction to radiation. Barakina, N.F.; Graevskii, E.Ya.; Nekrasova, I.V.; Yanuskevskaya, M.I.; Dontsova, G.V.; Rakhmanina, O.N. (Institute of Developmental Biology, Moscow, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 127-130(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 905-908(1978).

The effects on hemopoiesis of 2-amino-5,6-dihydro-4H-1,3-thiazine administered to mice prior to x irradiation was investigated. The radioprotective effectiveness of this substance was discussed.

19691 Effects of low doses of x-radiation on nonspecific defense systems and gamma globulin concentration in chick blood. Rudakov, V.V.; Tsikina, N.V. (Leningrad Veterinary Inst., USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 138-140(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 914-915(1978).

The effects of low doses of x radiation on the concentration of gamma globulins in blood and protein complexes absorbed on zymosan in chickens were investigated. Studies demonstrated that low doses of ionizing radiation enhanced the bactericidal properties and virus neutralizing properties of blood serum.

19692 Comparative effects on mice of radiation delivered in divided doses and continuously. Tikhomirova, L.K. *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 141-145(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 916-919(1978).

The effects of long-term delivery of divided doses and continuous exposure to radiation in mice were investigated. The dose-effect relationship for continuous and fractionated doses were discussed.

19693 Micronuclei in peripheral blood cells of Microtus oeconomus Pall. inhabiting areas with a high natural radioactive background. Materii, L.D.; Maslova, K.I. (Institute of Biology, Syktyvkar, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 146-149(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 919-922(1978).

The effects of high-gamma background radiation on the blood cells of voles were investigated. The morphology of the blood micronuclei of erythrocytes and lymphocytes of these voles were

compared with controls. Pathological changes and somatic mutations were discussed.

19694 Biometric indices of recirculating lymphocytes following acute and chronic gamma irradiation. Kalinin, E.V. (Ryazan' Medical Inst., USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 155-159(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 927-930(1978).

The effects of acute and chronic continuous gamma radiation on the lymphatic system organs and blood of mice were investigated. The radiosensitivity of the lymphoid cells was evaluated as a function size of the cell nucleus. The mass scale analysis of nuclei was performed cytologically.

19695 Evaluation of possibility of predicting individual radiosensitivity on the basis of reactions to nonradiation factors. Darenskaya, N.G.; Kuznetsova, S.S.; Chekhonadskii, N.A. *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 160-165(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 931-935(1978).

The reactions to nonradiation stress and radiation were comparatively evaluated in rats. Stress factors considered were fasting, overheating, and magnetic fields. The radiation source was cobalt 60. Based on reactions to stress factors, predictions were made on the outcome of radiation sickness for each animal.

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

ANIMALS

19696 Effect of immunization on mouse radioresistance to cesium 137. Kal'nitskii, S.A.; Ponomareva, T.V.; Shubik, V.M. (Scientific Research Inst. of Radiation Hygiene, Leningrad, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 100-104(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 246-250(1979).

It was demonstrated that a single prevaccination with a heated culture of Proteus vulgaris has a beneficial effect on resistance of white mice to radiation from incorporated ^{137}Cs. The effect was manifested by an increase in survival rate and life span of animals, rapid normalization of weight and leukocyte reaction, stimulation of recovery process in the spleen and faster elimination of the radionuclide.

19697 Recovery of some biological parameters after internal irradiation. Borisova, V.V.; Zapol'skaya, N.A.; Fedorova, A.V.; Yakovleva, N.G. (Scientific Research Inst. of Radiation Hygiene, Leningrad, USSR). *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 175-179(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 306-310(1979).

The rate of recovery of cellular elements in rat blood after single intake of cesium 137, strontium 90, cerium 133, or cerium 144 was studied. Histamine, acetylcholine, residual nitrogen, and deoxycytidine levels were monitored.

19698 Effects of low doses of americium 241 on animals. Rudnitskaya, E.I.; Moskalev, Yu.I. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 2, 180-186(Oct 1979).

Translated from Radiobiologiya; 19: No. 2, 310-316(1979).

The long term effects of low doses of americium 241 on dogs and rats were investigated. Americium chloride was administered intravenously to dogs and intraperitoneally to rats in varying doses. The biological radiation effects were determined at autopsy. Survival times were reported.

19699 Computer used to assess radiation effects of curium 244 alpha particles on the rat liver. Aref'eva, Z.S.; Zav'yalov, A.P.; Nazarov, V.A.; Rudnitskaya, E.I.; Khryashcheva, L.A. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 103-107(Oct 1979).

Translated from Radiobiologiya; 19: No. 1, 91-95(1979).

In this work an evaluation is given of the biological effect of curium 244 radiation on the rat liver 1, 4, 13 and 21 days after single administration of the radionuclide in a dosage of 0.25 μCi/g. Analysis of histological sections was made using a Minsk-32 digital computer. Processing of the results of primary computer analysis of optical scanograms by means of systems of hierarchic data analysis made it possible to demonstrate the phasic nature of changes in hepatic cell structures as a function of absorbed dose of ^{244}Cm α-radiation.

19700 Dose loads and genetic effects induced by single injection of selenomethionine containing small amounts of selenium 75. Report 1. Analysis of distribution and accretion of absorbed doses in mice. Norets, T.A.; Stepanenko, V.F.; Komarov, V.P. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 87-94(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 875-881(1978).

Mean dose loads generated in mice during the period of complete decay and elimination of the radionuclide, as well as absorbed doses in bone marrow and testes, with consideration of all components in the radiation spectrum of selenium 75 and mutual irradiation of organs, were calculated on the basis of the results of studies of dynamics of selenium 75 content in mice after single intravenous injection of selenomethionine. Dose rates and changes therein as a function of time, as well as dynamics of accretion of absorbed doses, are submitted.

19701 Dynamics of formed element content of peripheral blood, and survival of rats after discontinuation of chronic intake of tritium oxide. Voronin, V.S. *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 150-154(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 922-926(1978).

The long term effects of chronic intake of tritium oxide were investigated. Survival, life expectancy, and the dynamics of formed elements in rat blood were discussed.

19702 Thromboelastograms of dogs with acute and subacute lesions due to inhalation of americium 241 and plutonium 239 nitrates. Kalmykova, Z.I. *Radiobiology (USSR) (Engl. Transl.);* **18**: No. 6, 170-174(1978). (DOE-tr—4/12).

Translated from Radiobiologiya; 18: No.6, 939-943(1978).

The effects of inhalation of americium 241 and plutonium 231 on the clotting mechanism of dogs were investigated. Thromboelastograms of whole venous blood were used as the method for studying coagulation properties.

NUCLIDE KINETICS AND TOXICOLOGY

ANIMALS

REFER ALSO TO CITATION(S) 19593, 19595, 19700

19703 (DPSPU—79-30-3) **Radiation exposures in reprocessing facilities at the Savannah River Plant.** Hayes, G.; Caldwell, R.D.; Hall, R.M. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jun 1979. Contract EY-76-C-09-0001. 14p. (CONF-790654—2; IAEA-SM—242/36). Dep. NTIS, PC A02/MF A01.

From IAEA international symposium on occupational radiation exposure in nuclear fuel cycle facilities; Los Angeles, CA, USA (18 Jun 1979).

Two large reprocessing facilities have been operating at the Savannah River Plant since 1955. The plant, which is near Aiken, South Carolina, is operated for the US Department of Energy by the Du Pont Company. The reprocessing facilities have a work force of approximately 1,800. The major processes in the facilities are chemical separations of irradiated material, plutonium finishing, and waste management. This paper presents the annual radiation exposure for the reprocessing work force, particularly during the period 1965 through 1978. It also presents the collective and average individual annual exposures for various occupations including operators, mechanics, electricians, control laboratory technicians, and health physicists. Periodic and repetitive work activities that result in the highest radiation exposures are also described. The assimilation of radionuclides, particularly plutonium, by the work force is reviewed. Methods that have been developed to minimize the exposure of reprocessing personnel are described. The success of these methods is illustrated by experience - there has been no individual worker exposure of greater than 3.1 rems per year and only one plutonium assimilation greater than the maximum permissible body burden during the 24 years of operation of the facilities.

THERMAL EFFECTS

MICROORGANISMS

19704 (DP-MS—80-14) **Primary productivity, heterotrophy, metabolic indicators of stress and interactions in algal-bacterial mat communities affected by a fluctuating thermal regime.** Tison, D.L. (Rensselaer Polytechnic Inst., Troy, NY (USA)). Jan 1980. Contract EY-76-C-09-0001. 44p. Dep. NTIS, PC A03/MF A01.

Thesis. Portions of document are illegible.

Thermal habitats in effluent cooling waters from production nuclear reactors at the Savannah River Plant are unlike natural thermal habitats in that reactor operations are periodically halted, exposing the organisms growing in these thermal habitats to ambient temperatures for unpredictable lengths of time. Rates of primary production, glucose heterotrophy, and the composition of algal-bacterial mat communities growing along a thermal gradient from about 50 to 35°C during periods of reactor operation were studied. Cyanobacteria were the only photoautotrophs in mat communities above 40°C while cyanobacteria and eucaryotic algae comprised the photoautotrophic component of mat communities below 40°C. The heterotrophic component of these communities above 40°C was made up of stenothermic and eurythermic thermophilic bacteria

while both eurythermic thermophiles and mesophilic bacteria were found in communities below 40°C. Net CO_2-fixation rates during thermal conditions dropped after initial exposure to ambient temperatures. After prolonged exposure of the thermal communities to ambient temperatures, adaptation and colonization by mesophilic algae occurred. Rates of glucose utilization under varying degrees of thermal influence suggested that the heterotrophic component may not have been optimally adapted to thermal conditions. During periods of changing thermal conditions, an increase in the percentage extracellular release of photosynthetically fixed $^{14}CO_2$ by cyanobacteria and algae and an increase in the percentage of glucose mineralized (respired) by the heterotrophic component of the mat communities was observed. Results of temperature shift experiments indicated that the short-term response of the photoautotrophic component of these communities to thermal stress was an increase in the percentage of photosynthate released extracellularly. (ERB)

INVERTEBRATES

19705 (PB—296242) **A methodology for quantifying the responses of benthic communities to environmental perturbations. Final report.** Polgar, T.T.; Mrainak, G.M.; Pfitzenmeyer, H.T. (Martin Marietta Corp., Baltimore, MD (USA). Environmental Technology Center; Maryland Univ., Solomons (USA). Chesapeake Biological Lab.). Jan 1975. 92p. NTIS, PC A05/MF A01.

A multiple discriminant method of community analysis is explored and developed as a technique for characterizing and comparing benthic macrofaunal assemblages. The analysis is applied to data collected in the tidal portion of the Potomac River. The method clearly demonstrates that the responses of community structure to substrate variations can be described quantitatively. Arguments are presented for applying the method to the detection of community responses to environmental perturbations. Stratified sampling designs are required along an environmental gradient. Furthermore, the analysis provides for the identification of indicator species.

VERTEBRATES

19706 (PB—296252) **Estimates of the entrainment rate of spawn of the striped bass (morone saxatilis) into the proposed power plant at Douglas Point, final summary.** Warsh, K.L. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). 1977. 128p. NTIS, PC A07/MF A01.

A numerical model has been developed and run to simulate spawning in the Potomac River in Maryland and the entrainment of Striped Bass eggs and larvae by a proposed power plant at Douglas Point. The model includes a detailed simulation of the hydrology, spawning distributions, behavior of larvae, and plant operation. Model parameters were adjusted to reproduce the observed distributions of spawning in the river. A sensitivity analysis was conducted on the model to learn the consequences of possible errors or natural variability in the parameter ranges.

CHEMICALS METABOLISM AND TOXICITY

CELLS

19707 (AD-A—074180/1) **Direct exposure of monolayers of mammalian cells to airborne pollutants in a unique culture system. Final report, 1 June 1978-30 May 1979.** Rasmussen, R.E.; Crocker, T.T.; Samuelsen, G.S.; Witte, M.E.; Taylor, J.T. (California Univ., Irvine (USA)). Aug 1979. 41p. NTIS PC A03/MF A01.

A mammalian cell culture and exposure system has been developed that allows direct exposure of living cells to atmospheres containing pollutants such as oxidant gases and hydrocarbon vapors. The system is being used to detect cytotoxic effects of various airborne materials as well as their possible mutagenic effects. Oxidant gases include nitrogen dioxide and ozone; other materials include hydrazine, aircraft fuels, and known mutagens such as ethylmethane sulfonate and ethylene oxide. The goals of the project are to detect possible toxic effects of airborne materials and to determine whether synergistic effects may be produced in mixtures of materials found in the environment. Methods have been developed for the small-scale generation of atmospheres containing known mutagens and test materials including hydrazine and its derivatives and common aircraft fuels. Tests for mutagenic effects of gaseous nitrogen dioxide on cultures of hamster lung cells have been negative at concentrations up to 10 ppm in air. (Author)

19708 **Dichloromethane as a modulator of hemoglobin function.** Schoenborn, B.P.; North, B.E. (Brookhaven National Lab., Upton, NY). pp 1041-1047 of Frontiers of biological energetics. Volume 2. Washington, DC; Academic Press, Incorporated (1978).

Certain anesthetics and some other relatively chemically inert gases bind to proteins. These gas-protein complexes are stabilized purely by the weak Van der Waal's forces with binding energies of approximately 10 kcal. The effects of the binding of dichloromethane on the function of hemoglobin are reported. (ACR)

MICROORGANISMS

REFER ALSO TO CITATION(S) 19545, 19632

PLANTS

19709 (BNL—27251) **Mutagenicity of ambient air at selected sites in the United States using Tradescantia as a monitor.** Schairer, L.A. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 32p. (CONF-790951—2). Dep. NTIS, PC A03/MF A01.

From NATO advanced research institute on in vitro toxicity for environmental agents; Monte Carlo, Monaco (22 Sep 1979).

To fulfill the need for monitoring ambient airborne chemicals, the Tradescantia stamen hair system has been adapted for use in a mobile laboratory. Controlled laboratory exposures of Tradescantia flower buds to several gaseous mutagens were positive with significant responses at < 0.1 ppM of 1,2-dibromoethane. Mutational response increases linearly with duration of exposure up to about 21 days for both physical (radiation) and chemical mutagens. Hence the stamen hair system achieves its greatest sensitivity with chronic exposures typical of those in populated areas near industrial pollution sources. A mobile monitoring vehicle was assembled utilizing controlled-environment growth chambers for both ambient air fumigations and concurrent clean-air control exposures. Industrial sites monitored by the mobile laboratory were selected because of known increased coincidence of human cancer and/or high levels of pollutants in the vicinity. The ambient air at all sites near petroleum refineries gave positive mutagenic responses in the Tradescantia stamen hairs. Smelters and chemical industries showed more varied responses. Preliminary analyses indicate that the highest biological activity was associated with highest levels of vapor-phase organics, especially at the New Jersey site. (ERB)

19710 (UCRL—15209) **Interactive effects of SO_2 and O_3 on the yield of snap beans.** Bennett, J.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Dec 1979. Contract W-7405-ENG-48. 12p. Dep. NTIS, PC A02/MF A01.

During the summers of 1977 and 1978 two experiments were conducted testing the effects of SO_2 and $SO_2 + O_3$ on the yield of snap beans (Phaseolus vulgaris L.). The crops were planted in the field and fumigated with the gases within a minimum-interference facility developed by personnel of the Lawrence Livermore Laboratory. By providing a gradient of pollutant concentration along the planted rows, a continuum of treatments could be studied and the results analyzed by regression analysis. The objectives were to: (1) characterize the dose-response functions for snap beans and the pollutant treatments; (2) determine if synergistic responses occurred in the presence of $SO_2 + O_3$; and (3) evaluate how well the two runs of the experiment replicated each other. No significant differences were found between the SO_2 and the combined gas treatments in either year. There is strong evidence for a lack of interaction between SO_2 and O_3 in affecting bean yields in the field. The small differences between the two treatments in yield reductions, on the order of 10%, also corroborates this conclusion. This result is in opposition to earlier findings demonstrating a substantial difference in yield reduction between H_2S and $H_2S + O_3$. (ERB)

INVERTEBRATES

19711 (PNL-SA—8055) **Mercury in mussels of Bellingham Bay, Washington, (USA).** Roesijadi, G.; Drum, A.S.; Bridge, J.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1978. Contract EY-76-C-06-1830. 30p. (CONF-791179—1). Dep. NTIS, PC A03/MF A01.

From Symposium on pollution and physiology of marine organisms; Milford, CT, USA (6 Nov 1979).

Laboratory experiments demonstrated the existence of metallothionein-like, low molecular weight, mercury-binding proteins in the marine mussel Mytilus edulis. Relatively large quantities of mercury were associated with such proteins in gills and digestive gland, the organs of interest in the present study. ^{14}C-incorporation indicated induction of the protein in gills, but not in digestive gland. Mercury in digestive gland may have bound to existing metal-binding proteins. Short-term incorporation of mercury occurred primarily in gills. The induction of mercury-binding proteins in gills may have facilitated detoxification of mercury at the site of uptake. Mercury in mussels of Bellingham Bay were shown to have decreased from 1970 to 1978, the collection date for the present study. Mercury levels were low but approximately three times higher than those from uncontaminated areas. Mercury associated with the mercury-binding protein of gills and digestive glands of Bellingham Bay mussels were low and reflected the concentrations measured in the whole tissues. However, the highest concentration of mercury was

associated with the low molecular pool components, the identity of which is not presently known.

VERTEBRATES

19712 (COO—2737-8) **Temporal aspects of tumorigenic response to individual and mixed carcinogens. Progress report, October 1, 1978-September 30, 1979.** Albert, R.E.; Burns, F.J.; Altshuler, B. (New York Univ., NY (USA). Inst. of Environmental Medicine). Jun 1979. Contract AC02-76EV02737. 91p. Dep. NTIS, PC A05/MF A01.

The research proposed here is designed to obtain a better understanding of the temporal kinetics of tumor induction when one or more carcinogens are present simultaneously or sequentially for prolonged periods of time. Studies done to date under this contract have shown that carcinogenesis in mouse skin by polycyclic aromatic hydrocarbon carcinogens is consistent with the induction of dependent and autonomous cell transformations by the carcinogen followed by the conversion of autonomous tumor cells into malignancies at a rate which is determined by the level of carcinogen exposure. Dependent cell transformations remain latent in the skin unless expressed by a promoting agent. Dependent neoplasia appears to follow one-hit kinetics while malignancy is a multihit endpoint. Dose-related and time-related aspects of tumor induction are separable in the initiation-promotion system of mouse skin which along with rat skin and hamster lung is being used as a model for testing hypotheses. Results to date provide the basis for a new interpretation of the linear non-threshold extrapolation model. The broad aim of the study is to provide a basis or rationale for estimating risks associated with prolonged exposures to carcinogens found in the environment and to predict how different tissues and species respond to the carcinogens, promoters, and cocarcinogens.

19713 (PB—296226) **Investigations of the role of physical-transport processes in determing ichthyoplankton distributions in the Potomac River. Interim report.** Polgar, T.T.; Ulanowicz, R.E.; Pyne, D.A.; Krainak, G.M. (Martin Marietta Corp., Baltimore, MD (USA). Environmental Technology Center; Maryland Univ., Solomons (USA). Chesapeake Biological Lab.). Sep 1975. 145p. NTIS, PC A07/MF A01.

This report presents in-depth analyses of current meter records obtained from the deployment of continuously recording current meters in the Potomac estuary in 1974. The analyses of transport characteristics are presented in relation to the distribution of striped bass ichthyoplankton in the tidal portion of the Potomac River. The characteristics of ichthyoplankton distributions are described in terms of longitudinal, lateral, and time patterns of abundances. Estimates are made of the production and survival of various ichthyoplankton stages.

MAN

19714 (CONF-800303—13) **Biologically important compounds in synfuels processes.** Clark, B.R.; Ho, C.; Griest, W.H.; Guerin, M.R. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 26p. Dep. NTIS, PC A03/MF A01.

From 179. national meeting of the American Chemical Society; Houston, TX, USA (23 Mar 1980).

Crude products, by-products and wastes from synfuel processes contain a broad spectrum of chemical compounds - many of which are active in biological systems. Discerning which compound classes are most important is necessary in order to establish effective control over release or exposure. Polycyclic aromatic hydrocarbons (PAH), multialkylated PAH, primary aromatic amines and N-heterocyclic PAH are significant contributors to the overall mutagenic activities of a large number of materials examined. Ames test data show that the basic, primary aromatic amine fraction is the most active. PAHs, multialkylated PAHs and N-heterocyclic PAHs are all components of the neutral fraction. In nearly all cases, the neutral fractions contribute the largest portion of the mutagenic activity, while the basic primary aromatic amine fractions have the highest specific activity. Neutral fractions are usually the largest (wt %) whereas the total basic fractions are small by comparison; thus, the overall greater contribution of the neutral fraction to the mutagenic activity of most samples. Biologically active constituents are isolated in preparative scale amounts from complex mixtures utilizing combinations of liquid-liquid extraction and various liquid chromatographic column-eluant combinations. Fractions are characterized using a combination of spectroscopic techniques and gas chromatography/mass spectrometry.

19715 (PB—80-105554) **Biochemical changes in humans upon exposure to ozone and exercise.** Chaney, S.; DeWitt, P.; Blomquist, W.; Muller, K.; Bruce, R. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Aug 1979. 53p. NTIS, PC A04/MF A01.

A total of 44 human subjects were exposed to 784 micrograms/cu.m.(0.4 ppm) ozone and 30 human subjects were exposed to air as controls. A four hour exposure was given on each of five consecutive days. Half of each group received a higher level of treadmill exercise than the other half. Nine biochemical blood parameters were measured pre and post exposure: red blood cell glutathione reductase, vitamin E, red blood cell cholinesterase, red blood cell glucose-6-phosphate dehydrogenase, lactic acid dehydrogenase, complement C3, and IgM. Of these variables only vitamin E, red blood cell glucose-6-phosphate dehydrogenase, and complement C3 showed significant changes due to treatment.

19716 (PB—80-109119) **Investigation of selected potential environmental contaminants: ethylene glycol, propylene glycols and butylene glycols. Final report.** Miller, L.M. (Franklin Research Center, Philadelphia, PA (USA). Science Information Services Organization). May 1979. Contract EPA-68-01-3893. 270p. NTIS, PC A12/MF A01.

This report reviews aspects of production, use, environmental exposure and biological effects of ethylene glycol, two isomers of propylene glycol (1,2- and 1,3-propanediol) and four isomers of butylene glycol (1,3-, 1,4-, 2,3-, and 1,2- butanediol). Annual production of ethylene glycol is about 3.7 billion pounds for use primarily in antifreeze and polyester fiber. About 0.5 billion pounds of 1,2-propanediol are produced per year for use in polyester resins, food, pharmaceuticals, and cellophane. Annual domestic demand for 1,4-butanediol is about 0.2 billion pounds for use in the production of tetra-hydrofuran and acetylenic chemicals. The other title glycols are of less importance commercially. The major source of environmental contamination by ethylene glycol and 1,2-propanediol is likely from the disposal of spent antifreeze and de-icing fluids. However, limited monitoring data make it difficult to adequately assess environmental exposure to the glycols. The glycols are capable of being degraded by a variety of acclimated and unacclimated soil, water, and sewage microorganisms. In humans, ethylene glycol intoxication, usually as a result of accidental ingestion of antifreeze, may result in nausea, hypertension, tachycardia, cardiopulmonary failure, renal impairment, coma and death. 1,2-Propanediol is a GRAS food additive of low toxicity. 1,3-Butanediol has been studied as a source of dietary energy. Few studies are available on 1,2-, 2,3- and 1,4-butanediol or on 1,3-propanediol.

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

REFER ALSO TO CITATION(S) 18556, 19597, 19629

19717 (AD-A—074156/1) **Experimental validation of thermal retinal models of damage from laser radiation. Final report, August 1976-April 1978.** Welch, A.J.; Priebe, L.A.; Forster, L.D.; Gilbert, R.; Lee, C. (Texas Univ., Austin (USA). Bio-Medical Engineering Research Lab.). Aug 1979. Contract F33615-76-C-0605. 76p. NTIS PC A05/MF A01.

This research concerns the validation of a model for the mathematical prediction of laser-radiation thermal damage on the eye. The model developed by IITRI for the Air Force has four distinct steps: (1) The laser image at the retina is computed. (2) The amount of heat generated by absorption of light in the pigment epithelium, choriocapillaris, and choroid is computed. (3) This heat is used in the linear heat-conduction equation to calculate the laser-induced temperature rise in the eye. (4) The potential of damage for any point of the fundus is found with a sequence of first-order rate process equations which use the computed temperature-time histories. The University of Texas conducted a seris of dye cell and animal experiments for the purpose of validating the IITRI model. In the dye cell experiments, retinal absorption was modeled as a single homogeneous absorbing layer with known optical, thermal, and geometric parameters. In the second set of experiments the retinal intensity profile, temperature rise, threshold power, and extent of damage as a function of wavelength, beam radius, intensity distribution, and exposure duration in the monkey eye were measured.

19718 (DOE/CH/10025—1) **Assessment of the effects of the zero gravity environment on the health and safety of space workers. Summary report.** (National Aeronautics and Space Administration, Houston, TX (USA). Lyndon B. Johnson Space Center). 18 Feb 1980. Contract AI02-79CH10025. 16p. Dep. NTIS, PC A02/MF A01.

A review was conducted of currently available information relating to adverse effects to the health and safety that SPS space workers may experience. Currently available information on the responses of humans to space flight is somewhat limited and was obtained under conditions which are grossly different from conditions to be experienced by future space workers. The limitations in information and differences in conditions have been considered in the assessment of potential health and safety hazards to the SPS space workers. The study did not disclose any adverse effects that would result in long term deviations to the medical or physiological

health of space workers so long as proper preventive or ameleorating actions were taken.

19719 Respirable particulates generated by pressurized consumer products. I. Experimental method and general characteristics. Mokler, B.V.; Wong, B.A.; Snow, M.J. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM). Contract EY-76-C-04-1013. *Am. Ind. Hyg. Assoc. J.;* **40**: No. 4, 330-338(Apr 1979).

Many products and materials are available in the widely used pressurized package or aerosol form. A simulated breathing zone model approach has been developed and used characterize the particles to which a user may be exposed. Some products characterized under simulated worst reasonable conditions produced concentrations of particulates smaller than 6 μm aerodynamic diameter exceeding 50 mg/m^3.

19720 Respirable particulates generated by pressurized consumer products. II. Influence of experimental conditions. Mokler, B.V.; Wong, B.A.; Snow, M. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM). Contract EY-76-C-04-1013. *Am. Ind. Hyg. Assoc. J.;* **40**: No. 4, 339-347(Apr 1979).

The many products available in pressurized packages produce appreciable concentrations of particulates that may be deposited in the deep lung of human users. We have reported the size and concentration characteristics of these aerosols under carefully standardized conditions in a previous paper. These standard conditions have been varied to determine the influence of product discharge conditions on observed aerosol characteristics. The size characteristics are relatively insensitive to a wide range of changes in the discharge conditions; the only significant effect observed followed changing the target of the spray from a steel plate to a wig. The aerosol concentrations were changed by several experimental factors, but the relative changes were less than the estimated relative range of human exposure.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 19216

19721 Quantitative fit-test method for powered air-purifying respirators. Lowry, P.L.; Wheat, L.D.; Bustos, J.M. (Los Alamos Scientific Lab., NM). Contract W-7405-ENG-36. *Am. Ind. Hyg. Assoc. J.;* **40**: No. 4, 291-299(Apr 1979).

Current respirator approval regulations require that powered air-purifying respirators be worn by several persons into an atmosphere containing isoamyl acetate vapor and that none of the persons smell the characteristic odor of the isoamyl acetate. The National Institute for Occupational Safety and Health (NIOSH) has funded a project at the Los Alamos Scientific Laboratory (LASL) designed to develop a quantitative fit-test for powered air-purifying respirators so that the actual leakage rate of a known concentration of contaminant into the respiratory inlet covering can be measured with near real time analysis. The system developed uses a scattered light aerosol photometer for analysis and 25 mg/m^3 of submicrometer diameter dioctyl phthalate (DOP) aerosol as the contaminant. Five types of powered air-purifying respirators, all equipped with a full facepiece, a hood, or a helmet, were tested on 10 different people using this method. All of the devices provided protection factors of 1000 or better to all 10 people, and most of the tests showed protection factors greater than 10,000, where the protection factor is defined as the ratio of the challenge aerosol concentration to the aerosol concentration within the respiratory inlet covering.

GEOSCIENCES

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 18465, 18467, 18471, 19379, 19399, 19418, 19419, 19423, 19442, 19486, 19498, 19526, 19527, 19528, 19548

19722 (DOE/TIC—11059, pp 202-215) **Prediction of streamflow hazards.** Kirby, W. 1978.

In Geophysical predictions.

The physical and mathematical bases for predicting irregular events are set forth. The basic principles underlying streamflow forecasts and risk assessment are outlined: the hydrologic cycle and the hazard cycle are explained. The use of forecasts in planning for hazards is discussed. 5 figures, 1 table. (RWR)

19723 (PNL—3198) **Durability of metals from archaeological objects, metal meteorites, and native metals.** Johnson, A.B. Jr.; Francis, B. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1980. Contract EY-76-C-06-1830. 117p. Dep. NTIS, PC A06/MF A01.

Metal durability is an important consideration in the multibarrier nuclear waste storage concept. This study summarizes the ancient metals, the environments, and factors which appear to have contributed to metal longevity. Archaeological and radiochemical dating suggest that human use of metals began in the period 6000 to 7000 BC. Gold is clearly the most durable, but many objects fashioned from silver, copper, bronze, iron, lead, and tin have survived for several thousand years. Dry environments, such as tombs, appear to be optimum for metal preservation, but some metals have survived in shipwrecks for over a thousand years. The metal meteorites are Fe-base alloys with 5 to 60 wt% Ni and minor amounts of Co, I, and S. Some meteoritic masses with ages estimated to be 5,000 to 20,000 years have weathered very little, while other masses from the same meteorites are in advanced stages of weathering. Native metals are natural metallic ores. Approximately five million tonnes were mined from native copper deposits in Michigan. Copper masses from the Michigan deposits were transported by the Pleistocene glaciers. Areas on the copper surfaces which appear to represent glacial abrasion show minimal corrosion. Dry cooling tower technology has demonstrated that in pollution-free moist environments, metals fare better at temperatures above than below the dewpoint. Thus, in moderate temperature regimes, elevated temperatures may be useful rather than detrimental for exposures of metal to air. In liquid environments, relatively complex radiolysis reactions can occur, particularly where multiple species are present. A dry environment largely obviates radiolysis effects.

19724 Laboratory studies of water transport in rock salt. Hohlfelder, J.J.; Hadley, G.R. (Sandia Labs., Albuquerque, NM). Contract DE-AC04-76DP00789. *Lett. Heat Mass Transfer;* **6**: No. 4, 271-279(Jul 1979).

The transport of water through rock salt as a result of heating is examined experimentally and a new model proposed to explain the data. The experiment consists of the measurement of water loss rate as a fuction of time for three 1 kg blocks of Southeastern New Mexico rock salt. Each block was heated for approximately three days with maximum temperatures ranging from 165 to 250°C. The resulting data are qualitatively explained by a continuum model of Darcian flow of water vapor from a receding evaporation front. The model includes the prediction of thermal stresses which are calculated to crack the specimens during heater shutdown giving an anomalously high water loss spike in agreement with the data.

19725 Rio Grande rift and a diapiric mechanism for continental rifting. Bridwell, R.J. (Los Alamos Scientific Lab., NM). pp 73-80 of Tectonics and geophysics of continental rifts. Ramberg, I.B.; Neumann, E.R. (eds.). Dordrecht, Holland; D. Reidel Publishing Company (1978).

Continental rifts have been characterized by en echelon valleys which average 50 km in width, are bounded by extensional normal faults, and act as crustal lineaments of great length transecting broad, uplifted arches. Gravity, heat flow, and volcanism, relatively well known for the Rio Grande Rift, ovide models of the lithosphere which include variations in thickness, temperature, stress, and viscosity. Inclusion of the third dimension in the process of continental rifting implies a thinning of the lithosphere through intrusion of a high-temperature, less-dense, low-viscosity mantle diapir. This mass moves buoyantly upward, creating uplift, shear-stress concentrations in the crust beneath the rift, normal faulting, and attendent surface volcanism. 4 figures.

GEOPHYSICS

REFER ALSO TO CITATION(S) 18451

SEISMOLOGY AND TECTONICS

REFER ALSO TO CITATION(S) 19398

VOLCANOLOGY

REFER ALSO TO CITATION(S, 19292, 19437

GEOPHYSICAL SURVEY METHODS

REFER ALSO TO CITATION(S) 19396

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

19726 (LASL—79-83a) **Rock physics at Los Alamos Scientific Laboratory.** (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 11p. Dep. NTIS, PC A02/MF A01.

Rock physics refers to the study of static and dynamic chemical and physical properties of rocks and to phenomenological investigations of rocks reacting to man-made forces such as stress waves and fluid injection. A bibliography of rock physics references written by LASL staff members is given. Listing is by surname of first author. (RWR)

19727 (SAND—79-2318A) **Microcrack model and its significance to hydraulic fracturing and fracture toughness testing.** Schmidt, R.A. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 7p. (CONF-800507—2). Dep. NTIS, PC A02/MF A01.

From Rock mechanics symposium; Rolla, MO, USA (27 May 1980).

A rock mechanics/fracture mechanics model is formulated that describes the probable character of the microcrack zone at a crack tip in rock. Knowledge of the crack tip process zone is an important step in the general understanding of fracture propagation in rock. In particular, it may prove useful in descriptions and models of hydraulic fracture propagation near formation interfaces. Such a microcrack model is also needed in order to understand rock fracture testing on the laboratory scale and to help establish guidelines for fracture toughness testing. Initial calculations and results with this model reveal several explanations for anomalous behavior in hydraulic fracturing and in fracture toughness testing. 3 figures.

19728 (UCRL—83869) **Deformation of dolomite single crystals from 200-800°C.** Barber, D.J.; Heard, H.C.; Wenk, H.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Jan 1980. Contract W-7405-ENG-48. 4p. (CONF-800422—1). Dep. NTIS, PC A02/MF A01.

From International conference on effect of deformation on rocks; Gottingen, F.R. Germany (9 Apr 1980).

The stress-strain behavior of single-crystal dolomite was determined in uniaxial compression at 700 MPa effective pressure, 20° to 800°C, and at a strain rate of 1.3×10^{-5} s^{-1}. Six orientations of the principal stress axis to the crystallographic symmetry axes were tested. Comparison of the resulting stress-strain curves for each orientation indicates that dolomite is strongly anisotropic, with the strength increasing with temperature in five of the six orientations. In these five, the principal stress difference (at 2% permanent strain) increases by a factor of 1.5 to 2.5 over 780°C, with minor deviations. For the remaining orientation the strength decreases by a factor of 2 over the same temperature interval. In all orientations except one that favors twinning, the test pieces were found to have deformed by slip. Pre-annealing of the dolomite at 500°C usually produces a decrease in the strength (compared to the unannealed material), by up to a factor of 2, but this effect is shown only in the region of 20° to 250°C. 2 figures. (RWR)

GEOCHEMISTRY

REFER ALSO TO CITATION(S) 19408, 19726

OCEANOGRAPHY

REFER ALSO TO CITATION(S) 19560

19729 (DOE/TIC—11059, pp 155-165) **Tsunamis.** Loomis, H.G. 1978.

In Geophysical predictions.

The history of tsunami prediction is briefly summarized. Then the research related to a tsunami prediction made after the earthquake and before the arrival of the waves at various coastlines is discussed in some detail. Finally, some remarks are made concerning long-term predictions of tsunami flooding. This aspect is of interest due to federal laws about coastal zone management, flood insurance, and environmental and safety considerations for nuclear power plants and oil drilling and storage facilities. In conclusion, a glimpse into the future of this field is given. 4 figures. (RWR)

PHYSICS RESEARCH

ASTROPHYSICS AND COSMOLOGY

SOLAR PHENOMENA

19730 (DOE/TIC—11059, pp 69-81) **Solar variability and prediction.** White, O.R. 1978.

In Geophysical predictions.

Those parts of the solar output requiring prediction because their fluctuation interferes with essential activities are described, and the general question of solar variability is discussed. Rationale for the need for prediction of variation in the solar output is given first through consideration of how man's activities are affected. There are three types of variation of solar output: extremely rapid changes due to flares and other transients, slower variations produced by rotation and evolution of long-lived active regions, and the solar cycle; in this connection the solar radiation field, solar and galactic energetic particles, and the solar wind are examined. The capability for prediction of flares, average sunspot number, and long-term solar change is discussed. In conclusion, comments on a research program to improve solar prediction capability and impediments to a research program to study solar change are offered. 4 figures. (RWR)

19731 (DOE/TIC—11059, pp 96-102) **Sun and weather.** Wilcox, J.M. 1978.

In Geophysical predictions.

The question of whether changes in solar output (solar wind, flares, uv radiation) may influence weather and climate on earth is examined. The principal scientific problem at present is to establish the reality, or lack thereof, of sun-weather influences. Some work in this field is reported and its significance is evaluated. Societal concerns, the need for predictions, and prospects of improvement are discussed. 3 figures, 1 table. (RWR)

19732 **Relation between superheating and superacceleration of helium in the solar wind.** Neugebauer, M.M. (Jet Propulsion Lab., Pasadena, CA (USA)); Feldman, W.C. (Los Alamos Scientific Lab., NM (USA)). *Sol. Phys.;* **63**: No. 1, 201-205(Aug 1979).

Solar wind data obtained by the OGO-5 and IMP-6-8 Earth satellites show a positive correlation between the ratio of helium to hydrogen temperatures, Tsub(α)/Tsub(p), and the velocity difference between the two ions, vsub(α)-vsub(p). Although this result disagrees with the Prognoz-1 results reported earlier in this journal, it is consistent with the expected control by Coulomb collisions when the solar-wind density is high.

ATMOSPHERIC PHYSICS

19733 (CONF-7804163—(Vol.1), pp 671-681) **Theoretical analysis on remote sensing of atmospheric parameters by scintillations of light.** Hsiu-chi, C.; Run-heng, H.; Dar-ren, L. (Inst. of Atmospheric Physics, Academia Sinica, Peking, China). 1978.

From 12. international symposium on remote sensing of environment; Manila, Philippines (20 Apr 1978).

A numerical simulation is described from which information about the character of the atmospheric turbulence and wind can be extracted. If a Hankel's transformator could be constructed, it should be convenient to apply this method to atmospheric remote sensing using the scintillation effects of light in a turbulent medium. (FS)

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

BEAMS AND THEIR REACTIONS

19734 (DOE/ER/10464—1) **Study of electrons photoemitted from field emission tips. Progress report, July 1, 1979-March 1, 1980.** Reifenberger, R. (Purdue Univ., Lafayette, IN (USA)). Feb 1980. Contract AC02-79ER10464. 20p. Dep. NTIS, PC A02/MF A01.

Photo-induced field emission is a technique which studies electrons that have been photoemitted from a field emission tip. This new experimental method promises to combine the proven utility of both field emission and photoemission for investigating the electronic states near a metal surface. The primary objective of the research being performed is to investigate photo-induced field emitted electrons using a tuneable cw dye laser. To fully exploit this continuously tuneable photon source, a differential energy analyzer is being constructed to allow energy resolved measurements of the photofield emitted electrons. This report describes the progress made in implementing experiments on photo-induced field emission from July 1979 to March 1980.

19735 (UCRL-Trans—11549) **Shaping of H^- ion beams for accelerators in surface-plasma sources.** Derevyankin, G.E.; Dudnikov, V.G. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). Dec 1979. Translation of Preprint IYaF—79-17. 37p. Dep. NTIS, PC A03/MF A01.

The present paper considers the peculiarities of the shaping of H^- ion beams having a normalized luminosity of up to 10^8 A/cm^{2}rad^2 at an intensity of $\simeq$ 0.1 A in surface-plasma source (SPS). The influence of the operating conditions of SPS, shaping conditions, and other factors on the ion-optical characteristics of the beams formed was studied.

19736 **Effects of correlated lattice vibrations on surface backscattering yields.** Jackson, D.P. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.); Barrett, J.H. (Oak Ridge National Lab., TN (USA)). *Phys. Lett., A;* **71**: No. 4, 359-360(14 May 1979).

Equal-time displacement correlations are shown to predict significantly reduced ion backscattering yields from the surface of crystalline solids in comparison to yields without correlations.

COLLISION PHENOMENA

REFER ALSO TO CITATION(S) 18970

19737 (DOE/ET/15422—2) **Collisional energy transfer rate between two species. Volume II. Progress report.** Nichols, R.A. Jr.; Hernquist, L.E.; Smith, T.M.; Stoenescu, M.L. (ENCOTH Corp., Princeton, NJ (USA)). 1979. Contract AC02-79ET15422. 102p. Dep. NTIS, PC A06/MF A01.

A numerical formalism is developed for evaluating the collisional energy transfer rate between a general nonequilibrium species and a maxwellian speces. Two methods are described, one consists of a standard formulation based on a direct integration of the average energy transfer between one particle and a species during one collision, the second method consists of a matrix summation over particle flux rate in the velocity space. The methods are equivalent as far as physical results. Evaluations are presented for electrons colliding elastically with cesium or hydrogen atoms for maxwellian distributions of the heavy species. Integrations over an arbitrary electron distribution chosen to be maxwellian are performed in order to compare the results with the temperature dependence of the energy transfer rate between two maxwellian species, evaluated independently.

19738 (LBL—9527) **Photoelectron spectroscopy of heavy atoms and molecules.** White, M.G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. 154p. Dep. NTIS, PC A08/MF A01.

Thesis.

The importance of relativistic interactions in the photoionization of heavy atoms and molecules has been investigated by the technique of photoelectron spectroscopy. In particular, experiments are reported which illustrate the effects of the spin-orbit interaction in the neutral ground state, final ionic states and continuum states of the photoionization target.

19739 **Dissociative electron attachment to the metastable c ^{3}PIμ state of molecular hydrogen.** Bottcher, C. (Oak Ridge National Lab., TN (USA)); Buckley, B.D. *J. Phys., B (London);* **12**: No. 16, L497-L500(28 Aug 1979).

The $H_2$$^{-2}$PIsub(u) resonance calculated by Buckley and Bottcher (J. Phys. B.; 10: L635 (1977)) is used in an estimation of the cross section for dissociative electron attachment (DA) to the metastable c^{3}PIsub(u) state of molecular hydrogen. The cross section is found to be substantially larger than that for DA to the low vibrational levels of the ground electronic state $X^1\Sigma^+$sub(g). It appears that DA to C^{3}PIsub(u) could play an important role in the production of the relatively high densities of negative ions in low-density hydrogenic plasma observed by Nicolopoulou et al (J. Physique, 38: 1399 (1977)).

ATOMIC AND MOLECULAR THEORY

REFER ALSO TO CITATION(S) 19760

FLUID PHYSICS

REFER ALSO TO CITATION(S) 19166

GENERAL FLUID DYNAMICS

19740 (SAND—79-8775) **Velocity and temperature measurements in turbulent diffusion flames.** Rambach, G.D.; Dibble, R.W.; Hollenbach, R.E. (Sandia Labs., Livermore, CA (USA)). Feb 1980. Contract EY-76-C-04-0789. 56p. (CONF-791048—6). Dep. NTIS, PC A04/MF A01.

From The Combustion Institute Western States Section meeting; Berkeley, CA, USA (15 Oct 1979).

Non-intrusive, time- and space-resolved measurements of velocity and temperature were performed in turbulent diffusion flames. The velocity measurements were made with a Laser Doppler Velocimeter on a confined turbulent hydrogen diffusion flame in coflowing air. Mean velocity, velocity standard deviation and turbulence intensity profiles were produced and compared with high speed shadowgraph movies and a visual measurements of the flame boundaries. Single point velocity probability density functions (pdf) were also produced for all spatial measurement points. Temperature measurements were made using Rayleigh scattering on an unconfined turbulent diffusion flame. The fuel and its products had approximately the same Rayleigh scattering cross-section as air so that temperature could be inferred directly from the scattering intensity using the state equation for a perfect gas. The temperature measurements also include the probability density functions at several locations.

MAGNETOHYDRODYNAMICS

REFER ALSO TO CITATION(S) 19812

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

REFER ALSO TO CITATION(S) 19748

19741 (RLO—2225-T27-11) **High energy physics studies of particle interactions and the search for new particles. Annual progress report, May 15, 1979-May 14, 1980.** Lord, J.J.; Wilkes, R.J. (Washington Univ., Seattle (USA)). 14 Feb 1980. Contract EY-76-S-06-2225-027. 28p. Dep. NTIS, PC A03/MF A01.

A research program to investigate several aspects of the hadronic interaction process at very high energies through nuclear emulsion techniques continues. An experiment at Fermilab searched for new particle production by neutrino interactions in nuclear emulsion targets inside the 15' bubble chamber. In this hybrid experiment, the deuterium-filled bubble chamber provided a rough location for the interaction vertex, and identified and momentum-analyzed the produced particles, while the emulsion provided a close look at the event vertex. A second exposure is planned for late 1980. Continued effort was directed to the study of multiparticle production processes in nuclei. In the earlier phases of this contract, protons and pions were used as the projectile; within the last few years, leptoproduction and nucleus-nucleus interactions have been investigated. There is, of course, considerable theoretical interest in this topic, since the development of intranuclear cascades, their multiplicities, and rapidity distributions are strongly dependent on the nature of the first interaction of the incident particle.

19742 **Particle Data Group's experience in handling systematic errors: a retrospective study of 18 years of reviewing particle properties.** Rosenfeld, A.H.; Stevens, P.R. pp 19-23 of Proceedings of the fifth biennial international CODATA conference. Dreyfus, B. (ed.). Elmsford, NY; Pergamon Press Inc. (1977).

From 5. CODATA conference; Boulder, CO, USA (28 Jun 1976).

For the past 18 years, the Particle Data Group (PDG) has compiled data on, and computer averages for, the properties of elementary particles. In the course of this work, it has become apparent that experimenters frequently underestimate the errors which they report on the quantities they measure, presumably due to their not accounting sufficiently for systematics. To deal with this problem, several techniques were adopted, including the use of ideograms to display graphically the discrepancies between various measurements (in terms of their errors) and the use of a variable scale factor to enlarge the error quoted by PDG on the combined average of several experiments. The calculation of the scale factor is based on the amount of the discrepancy existing among the most significant experiments, plus some personal judgment. It was found that, with such a factor, the errors quoted by PDG seem to hold up, in the sense that later, and presumably more accurate, averages deviate from earlier ones by roughly what one would expect on the basis of statistics. This is true for the vast number of averages quoted; only a small number of cases exist where a large discrepancy exists between an early average and a later one. The causes of such large changes are certainly systematic, but have not beem determined as yet. 3 figures.

ELECTROMAGNETIC INTERACTIONS

19743 (COO—2853-12) **M4 transitions in ^{13}C.** Hicks, R.S.; Lindgren, R.A.; Parker, B.; Peterson, G.A.; Thiessen, H.; Crannell, H.; Sober, D. (Massachusetts Univ., Amherst (USA); Los Alamos Scientific Lab., NM (USA); Catholic Univ. of America, Washington, DC). 1980. Contract EY-76-S-02-2853. 3p. (CONF-800131—4). Dep. NTIS, MF A01.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Portions of document are illegible.

The possible existence of two strong $l = 4$ transitions in ^{13}C, one to be a state at 21.4 MeV excitation energy, and the other at 9.5 MeV is discussed. (GHT)

19744 **Jets in e^+e^- annihilation.** Hanson, G.G. (Stanford Linear Accelerator Center, CA (USA)). pp 15-42 of Gauge theories and leptons. Vol. 2. Proceedings of the 13. Rencontre de Moriond, Les Arcs, 12-24 March 1978. Tran Thanh Van, J. (ed.). Gif-sur-Yvette, France (B.P. 44); Editions Frontieres (1978).

The latest results on R, the ratio of the total cross section for production of multihadronic events to the muon pair production cross section, and inclusive distributions of hadrons from e^+e^- annihilation in the center-of-mass energy range from 2.6 to 7.8 GeV are presented. The evidence for jet structure is reviewed. Inclusive distributions of hadrons in Feynman x, rapidity, and transverse momentum relative to the jet direction are studied. Particular emphasis is placed on the method used to measure these inclusive distributions and the biases which might result from this method.

19745 (SLAC-PUB—2461) **Production of resonances in photon-photon collisions.** Gilman, F.J. (Stanford Linear Accelerator Center, CA (USA)). Jan 1980. Contract EY-76-C-03-0515. 18p. (CONF-7908102—2). Dep. NTIS, PC A02/MF A01.

From International conference on two-photon interactions; Lake Tahoe, CA, USA (30 Aug 1979).

The subject of production of resonances via two photons in z^+ e- colliding beams has finally come into its own. In particular, the eta meson is already changing from this year's sensation to next year's normalization. As for the other old physics mesons with even charge conjugation it seems likely that measurements of the scalar and tensor mesons coupling to two photons are quite doable and will be forthcoming. These will yield some interesting information on the quark content of these states and/or the dynamics of their two photon decays. As for the charmonium states, a measurement of some of the two photon decay widths would be quite interesting in terms of the information it gives on the dynamics of this system. However, even at LEP energies the cross sections for production of any particular state are rather small and one must be lucky to have a detectable decay mode or modes with substantial branching fraction. Finally, there is the π^0 which started the whole subject. A measurement of this coupling is much easier using the complementary technique for determining two photon widths-the Primakoff effect. $\Gamma(\pi^0 \rightarrow \gamma\gamma)$ has long since been measured with high accuracy in this way.

WEAK INTERACTIONS

19746 **Tau lepton.** Feldman, G.J. (Stanford Linear Accelerator Center, CA (USA)). *Comments Nucl. Part. Phys.;* **9**: No. 1, 23-29(Aug 1979).

The results of nine experiments undertaken to measure tau particle properties, since the discovery of this charged lepton in 1975 by the SLAC-LBL collaboration, are considered. The decay modes, masses, spin, lifetime, and tau - ν/sub tau/ coupling are discussed. It is concluded that all the evidence is consistent with the tau being a sequential lepton decaying to its own massless neutrino with a V - A coupling.

STRONG BARYON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 19792

19747 (ORO—5224-3, pp 66-74) **Pion-deuteron production using 0.8 GeV protons on hydrogen.** Dec 1979.

In Research in experimental nuclear physics. Progress report, April 1, 1979-March 31, 1980.

Polarization parameters occurring in the expression for the differential cross section of the $pp \rightarrow d\pi^+$ reaction were measured. The theoretical fit to the cross section data obtained is also shown. 5 figures. (RWR)

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

ELECTROMAGNETIC INTERACTIONS

19748 (SLAC-PUB—2450) **Heavy leptons.** Tsai, Y.S. (Stanford Linear Accelerator Center, CA (USA)). Dec 1979. Contract EY-76-C-03-0515. 29p. (CONF-800120—2). Dep. NTIS, PC A03/MF A01.

From Conference on theoretical particle physics; Guangchou, China (5 Jan 1980).

Experimental and theoretical aspects of heavy leptons are reviewed.

WEAK INTERACTIONS

19749 **Weak interactions.** Bjorken, J.D. (Stanford Linear Accelerator Center, CA (USA)). pp v.2 p.491-499 of Gauge theories and leptons. Proceedings of the 13. Rencontre de Moriond, Les Arcs, 12-24 March 1978. Tran Thanh Van, J. (ed.). Gif-sur-Yvette, France (B.P. 44); Editions Frontieres (1978).

Weak interactions are studied from a phenomenological point of view, by using a minimal number of theoretical hypotheses. Charged-current phenomenology, and then neutral-current phenomenology are discussed. This all is described in terms of a global SU(2) symmetry plus an electromagnetic correction. The intermediate-boson hypothesis is introduced and lower bounds on the range of the weak force are inferred. This phenomenology does not yet reconstruct all the predictions of the conventional SU(2)xU(1) gauge theory. To do that requires an additional assumption of restoration of SU(2) symmetry at asymptotic energies.

STRONG INTERACTIONS, GENERAL

19750 (DOE/ER/01545—271) **Zero-point energy in bag models.** Milton, K.A. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1979. Contract EY-76-C-02-1545. 11p. Dep. NTIS, PC A02/MF A01.

The zero-point (Casimir) energy of free vector (gluon) fields confined to a spherical cavity (bag) is computed. With a suitable renormalization the result for eight gluons is $E = +0.51/a$. This result is substantially larger than that for a spherical shell (where both interior and exterior modes are present), and so affects Johnson's model of the QCD vacuum. It is also smaller than, and of opposite sign to, the value used in bag model phenomenology, so it will have important implications there. 1 figure.

19751 (DOE/ER/70004—232) **Some recent developments in the recombination model.** Hwa, R.C. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science). 1979. Contract EY-76-S-06-2230-004. 11p. (RLO—2230-T4-232; CONF-7905142—1). Dep. NTIS, PC A02/MF A01.

From 2. international symposium on hadron structure and multiparticle production; Kazimierz, Poland (20 May 1979).

A critical review of the recombination model for hadron production at low P/sub T/ is first given, emphasizing not so much the successes as unanswered questions that the model faces. A systematic program to answer some of the basic questions is then developed. The theoretical framework is quantum chromodynamics. First, in what may appear as a digression, the possibility of formation of valence quark clusters (called valons) in a nucleon due to gluon bremsstrahlung and quark-pair creation is considered. Evidences are found not only for the valons in neutrino scattering data, but also indications for their momentum distribution in a nucleon. When similar considerations are applied to a meson, the meaning of the recombination function is discussed and its normalization as well as its shape are determined. Next, the problem of quark decay in a hard scattering process (e.g., pion production in e^+e^- annihilation) is considered. The joint distribution of partons in a quark jet is determined in QCD. The quark decay function for pions in the recombination model is then obtained with excellent fit to the data. Similar investigation is applied to the problem of photoproduction of pions in the fragmentation region; again good agreement with data is achieved. The results indicate the reliability of the recombination model when the two-parton distributions can be calculated in QCD. Finally, hadron initiated reactions are considered. A duality between quark recombination and valon fragmentation is suggested. The picture is consistent with dual Regge model. A possible way to determine the inclusive distribution in the context of QCD is suggested.

19752 **Particle order: a new fundamental concept in hadron physics. Pt. 2.** Weissmann, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Int. J. Theor. Phys.;* **17**: No. 11, 853-929(Nov 1978).

The concept of particle order introduced in Part I is extended to all hadrons by a generalization of the concept of order. Stringent self-consistency requirements are shown to determine the specific form of the theory, including such features as topological color,

baryon number conservation, and a set of generalized OZI rules. The spectrum is shown to consist of nonexotic mesons and baryons, and well defined classes of exotic particles, all obeying the zero-triality rule. An attempt is made to understand the physical interpretation of order, which may well turn out to be a most fundamental concept in hadron physics.

STRONG INTERACTIONS, BARYON NO.=0

19753 Particle order: a new fundamental concept in hadron physics. Pt. 1. Weissmann, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Int. J. Theor. Phys.;* **17**: No. 10, 747-852(Oct 1978).

In Part One the concept of particle order is introduced in its simplest form, sequential order. It is shown how sequential order, together with the general principles of S-matrix, (1) reproduces the main predictions of quark models with respect to mesons, explaining their quarklike spectrum without any need to assume the existence of quarks as constituent particles; and (2) provides a theoretical foundation for duality, in particular the dual unitarization (topological expansion) approach; and hence provides a unified description for a broad range of mesonic regularities such as the origin of conserved internal quantum numbers, the nature of the mesonic spectrum, the OZI rule and its violations, Regge pole dominance, exchange and I-spin degeneracy and their breaking, the Pomeron, etc.

STRONG INTERACTIONS, BARYON NO. GREATER THAN 1

19754 /sub Λ/^{4}He-/sub Λ/^{4}H binding energy difference. Gibson, B.F. (Los Alamos Scientific Lab., NM (USA)); Lehman, D.R. (George Washington Univ., Washington, DC (USA)). *Phys. Lett., B;* **83**: No. 3-4, 289-292(21 May 1979).

The /sub Λ/^{4}He-/sub Λ/^{4}H binding energy difference is studied using separable Λ-p and Λ-n interactions. The result of the exact 4-body calculation is found to be more than twice the result of an effective 2-body model calculation.

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

APPLICATIONS TO ELECTROMAGNETIC AND WEAK INTERACTIONS

19755 (DOE/ER/01545—272) **Pseudoscalar decay constants and eta → 3π in chiral and 1/N perturbation theory.** Milton, K.A.; Palmer, W.F.; Pinsky, S.S. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1980. Contract EY-76-C-02-1545. 13p. Dep. NTIS, PC A02/MF A01.

The normal and anomalous chiral Ward identities are reexamined from the point of view of chiral and 1/ perturbation theory. Constraints of psi → eta γ and psi → eta' γ and pseudoscalar two photon decays are imposed, yielding a system of six simultaneous equations. A solution for the pseudoscalar decay constants is found which is relatively insensitive to the unknown gluonic bound states. The decay eta → 3π is then calculated using these results, with good agreement with recent measurements.

FIELD THEORY

REFER ALSO TO CITATION(S) 19750

19756 (LA-UR—80-913) **On the n-p mass difference in QCD.** West, G.B. (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 22p. (CONF-800123—3). Dep. NTIS, PC A02/MF A01.

From Orbis Scientiae; Coral Gables, FL, USA (14 Jan 1980).

The radiative contribution to Δm, the n-p mass difference, is discussed in terms of dynamical symmetry breaking and gauge boson radiative corrections. (GHT)

PHYSICS RESEARCH

NUCLEAR PHYSICS

19757 (BNL-NCS—17541(Ed.3)) **ENDF/B summary documentation.** Kinsey, R. (comp.). (Brookhaven National Lab., Upton, NY (USA)). Jul 1979. Contract EY-76-C-02-0016. 525p. (ENDF—201(Ed.3)). Dep. NTIS, PC A22/MF A01.

This publication provides a localized source of descriptions for the evaluations contained in the ENDF/B Library. The summary documentation presented is intended to be a more detailed description than the (File 1) comments contained in the computer readable data files, but not so detailed as the formal reports describing each ENDF/B evaluation. The summary documentations were written by the CSEWB (Cross Section Evaluation Working Group) evaluators and compiled by NNDC (National Nuclear Data Center). This edition includes documentation for materials found on ENDF/B Version V tapes 501 to 516 (General Purpose File) excluding tape 504. ENDF/B-V also includes tapes containing partial evaluations for the Special Purpose Actinide (521, 522), Dosimetry (531), Activation (532), Gas Production (533), and Fission Product (541-546) files. The materials found on these tapes are documented elsewhere. Some of the evaluation descriptions in this report contain cross sections or energy level information. (RWR)

19758 (COO—535-767) **University of Colorado, Nuclear Physics Laboratory technical progress report, November 1, 1978-October 31, 1979. Report NPL-845.** (Colorado Univ., Boulder (USA). Dept. of Physics and Astrophysics). 1 Nov 1979. Contract EY-76-C-02-0535. 225p. Dep. NTIS, PC A10/MF A01.

This report summarizes work carried out at the Nuclear Physics Laboratory of the University of Colorado from November 1, 1978 to October 31, 1979, under contract EY-76-C-02-0535.A003 between the University of Colorado and the United States Department of Energy. Experimental studies of light ion-induced reactions were performed with the AVF cyclotron, which continues each year to produce beams of yet higher quality. Charged-particle studies continued to emphasize use of the high-resolution spectrometer system, but some return to broad-range spectroscopic studies using solid state detectors also occurred. Neutron time-of-flight experiments used 9-meter and 30-meter flight paths. Neutron-gamma ray coincidence studies developed into a new and promising field. The new PDP 11/34 data acquisition system was of great value in allowing such multiparameter experiments. Smaller programs in nuclear astrophysics, plasma diagnostic development, and medical physics were also undertaken. Research activities based at other accelerators grew. Studies of future directions for light-ion accelerators, including work on intense pulsed ion sources, orbit dynamics, and storage rings, were greatly enlarged. 19 of the articles in this report were abstracted and indexed individually. Lists of publications and personnel conclude this report. (RWR)

19759 (ORNL/TM—7309) **Report to the DOE Nuclear Data Committee.** Lundy, J.C.; Perey, F.G. (comps.). (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 25p. Dep. NTIS, PC A02/MF A01.

This report was prepared for the DOE Nuclear Data Committee and covers work performed at ORNL since April 1979 in areas of nuclear data of relevance to the US applied nuclear energy program. The report was mostly generated through a review of abstracts of work completed to the point of being subjected to some form of publication in the open literature, formal ORNL reports, ORNL technical memoranda, progress reports, or presentation at technical conferences. As much as possible the complete abstract of the original publication is reproduced with only minor editing. In a few cases progress reports were written specifically for this publication. The editors selected the materials to be included in this report on the basis of perceived interests of DOE Nuclear Data Committee members and cannot claim completeness. Material is grouped as follows: Nuclear Cross Sections for Technology conference, cross section measurements, data analyses, and Nuclear Data Project activities for 1979. 2 figures.

19760 (ORO—2408-154) **Progress report, 1 January-31 December, 1979.** (North Carolina Univ., Chapel Hill (USA)). 1979. Contract EY-76-S-05-2408. 37p. Dep. NTIS, PC A03/MF A01.

Research performed during the year 1979 is summarized. Areas of interest included proton-induced reactions, deuteron-induced reactions, polarized-ion source development, studies with polarized neutrons, nuclear and atomic theory, and related activities. As most of the activities are adequately described in other reports and journal publications, no data are presented here. (RWR)

19761 (ORO—5224-3) **Research in experimental nuclear physics. Progress report, April 1, 1979-March 31, 1980.** (Texas Univ., Austin (USA); Department of Energy, Washington, DC (USA)). Dec 1979. Contract EY-76-S-05-5224. 87p. Dep. NTIS, PC A05/MF A01.

This report summarizes work carried out by the University of Texas at Austin at LAMPF during the period April 1, 1979, to March 31, 1980. Research activities involved experiments done with the Energetic Pion Channel and Spectrometer (EPICS) and the external proton beam. Research activities are described, and lists of publications, abstracts, personnel, and acknowledgements are given. A separate abstract was written for each of the seven research reports. (RWR)

19762 **Computer processing of free-text keyword strings.** Ewbank, W.B. (Oak Ridge National Lab., TN). pp 119-122 of Proceedings of the fifth biennial international CODATA conference. Dreyfus, B. (ed.). Elmsford, NY; Pergamon Press Inc. (1977).

From 5. CODATA conference; Boulder, CO, USA (28 Jun 1976).

The Nuclear Data Project devised a system for tagging each new publication according to its specific data content by means of author-prepared keyword abstracts. The structure and processing of keyword abstracts is described. The master file of nuclear structure references thus produced is used to prepare various indexes, current awareness tools, SDI services, and tapes for complex interactive searches with the DOE/RECON system. Special features contributing to the success of this keyword system are discussed. 7 figures. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, THEORETICAL

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 19754, 19799

NUCLEAR REACTIONS AND SCATTERING

19763 (COO—535-767, pp 185-190) **Evidence for pion exchange currents in the analysis of the ^{4}He(p,d)^{3}He reaction at intermediate energies.** Shepard, J.R.; Rost, E.; Smith, G.R. 1 Nov 1979.

In University of Colorado, Nuclear Physics Laboratory technical progress report, November 1, 1978-October 31, 1979.

The ^{4}He(p,d)^{3}He reaction at 434 and 770 MeV is qualitatively understandable in a one-nucleon-transfer model using quasi-phenomenological distortions obtained from proton elastic scattering experiments. The crucial difference from earlier work is the construction of the n-^{3}He wave function from electron scattering data with pion-exchange effects subtracted from the measured charge form factor so as to give a true nucleon density. Exact finite-range DWBA predictions with and without the corrections due to meson exchange are compared with experimental data for the angular distribution at 434 and 770 MeV and the excitation function from 200 to 800 MeV. 5 figures, 1 table. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

19764 (COO—535-767, pp 130-134) **Elastic π^- scattering from ^{3}He at 50 MeV.** Masterson, T.G.; Kraushaar, J.J.; Johnson, R.R.; Barnett, B.; Gyles, B.; Gill, D.; alster, J. 1 Nov 1979.

In University of Colorado, Nuclear Physics Laboratory technical progress report, November 1, 1978-October 31, 1979.

Elastic scattering of 49.2-MeV π^- from a liquid ^{3}He target was measured. An angular distribution is given. 2 figures, 1 table. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=6-19 THEORETICAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 19765

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 19779, 19799, 19800

19765 (DOE/ER/10364—5) **Resonating-group study of the α + ^{15}N system.** LeMere, M.; Tang, Y.C. (Minnesota Univ., Minneapolis (USA). School of Physics). 1978. Contract AC02-79ER10364. 14p. Dep. NTIS, PC A02/MF A01.

The resonating-group method is used to study the α + ^{15}N system. The result shows that, with the use of a reasonable nucleon-nucleon interaction and a phenomenological imaginary potential, the calculation can yield a differential cross section that agrees rather well with experimental data. In addition, one learns from this study useful information concerning the cluster structures of many bound and resonance levels in the compound nucleus, ^{19}F. 3 figures.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 19778

19766 (COO—535-767, pp 124-126) **Measurement of the charge radius of ^{11}B with elastic π^+ scattering.** Masterson, T.G.; Kraushaar, J.J.; Lepp, S.; Rost, E.; Johnson, R.R.; Barnett, B.; Gyles, B.; Gill, D.; Thomas, A.W.; Alster, J. 1 Nov 1979.

In University of Colorado, Nuclear Physics Laboratory technical progress report, November 1, 1978-October 31, 1979.

An rms charge radius for ^{11}B of 2.25+- 0.03 fm was determined from ^{11}B-^{12}C angular distribution ratio measurements at 50 MeV. Calculations of angular distribution ratios for ^{11}B-^{12}C and ^{15}N-^{16}O are also shown. 3 figures. (RWR)

19767 (COO—535-767, pp 126-129) **Neutron radii determinations from the ratios of π^- elastic scattering from ^{12} ^{13}C and ^{16} ^{18}O.** Masterson, T.G.; Kraushaar, J.J.; Rost, E. 1 Nov 1979.

In University of Colorado, Nuclear Physics Laboratory technical progress report, November 1, 1978-October 31, 1979.

Determination of the radius of the nuclear neutron distribution by low-energy π^- scattering from a pair of isotopes is explained. Results are given for ^{13}C and ^{18}O. Elastic scattering differential cross sections are shown for ^{12}C and ^{13}C at 29.2 and 49.5 MeV and for ^{16}O and ^{18}O at 29.2 MeV. 4 figures, 1 tables. (RWR)

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 19769

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 19767, 19779, 19782

19768 (AD-A—074310/4) **The ^{11}B(p,n)^{11}C reaction: measurements of differential cross sections at proton energies between 3.1 and 4.5 MeV, and applications to depth profiling. Final report.** Ebright, R.P. (Army Military Personnel Center, Alexandria, VA (USA)). 24 Aug 1979. 109p. NTIS PC A06/MF A01.

Thick-target neutron time-of-flight techniques have been used to study the ^{11}B(p,n)^{11}C reaction at proton energies from threshold to 4.5 MeV. Neutron time-of-flight spectra were obtained at laboratory angles of 0, 20, 31, 50, 69.8, 80.3, 90, 100, 114, 138.2 and 155 degrees, and converted to cross sections averaged over 10 keV intervals in proton energy. Targets of polycrystalline boron and B_2O_3 were used. Boron concentrations in Si and SiO_2 targets of otherwise known composition were determined using the ^{11}B(p,n)^{11}C reaction with neutron time-of-flight techniques. The concentration was determined by taking the ratio of neutron time-of-flight spectra from a pure B metal target and a target of unknown boron content. This technique was applied to a Si wafer implanted in the <100> direction with 200 keV atoms.

19769 (COO—535-767, pp 42-43) **Results from the ^{10}B(^{3}He,n)^{12}N reaction.** Peterson, R.J.; Cecil, F.E.; Sercely, R.R. 1 Nov 1979.

In University of Colorado, Nuclear Physics Laboratory technical progress report, November 1, 1978-October 31, 1979.

The angular distribution from tthe ^{10}B(^{3}He,n)^{12}N reaction at 25.4 MeV to the 5.32-MeV state is shown. A distinctive L = 0 pattern confirms the 3$^+$ assignment for this state. 1 figure. (RWR)

19770 (COO—535-767, pp 113-119) **^{6}Li, ^{7}Li, ^{12}C, ^{13}C(π^+,p) reaction on and off the (3,3) resonance.** Smith, G.R.; Anderson, R.E.; Boudrie, R.L. 1 Nov 1979.

In University of Colorado, Nuclear Physics Laboratory technical progress report, November 1, 1978-October 31, 1979.

Representative spectra from the ^{6}Li(π^+,p) and ^{7}Li(π^+,p) reactions at 175 MeV are shown, along with angular distributions from the latter reaction at 75 and 175 MeV. The shapes of 1$^+$ and 3$^+$ angular distributions are nearly identical. The spectra of ^{12}C(π^+,p) and ^{13}C(π^+,p) reactions at 180 MeV are remarkably similar to those of ^{12}C(p,d) and ^{13}C(p,d) reactions at 800 MeV and the same momentum transfer: a similar reaction mechanism is indicated. Angular distributions are presented for ^{12}C(π^+,p) at 90 and 180 MeV and ^{13}C(π^+,p) at 90 and 170 MeV; they are structureless. 6 figures. (RWR)

19771 (COO—535-767, pp 135-137) **Studies of the (p,d) reaction on ^{7}Li, ^{13}C and ^{16}O at 200 and 400 MeV.** Kraushaar, J.J.; Hutcheon, D.A.; Liljestrand, R. 1 Nov 1979.

In University of Colorado, Nuclear Physics Laboratory technical progress report, November 1, 1978-October 31, 1979.

Cross sections and analyzing powers for the ^{13}C(p-vector,d)^{12}C reaction to the ground and 4.44-MeV states are reported for a proton energy of 200 MeV. Exact finite-range DWBA calculations with and without spin-orbit coupling were performed. 2 figures. (RWR)

19772 (COO—535-767, pp 141-145) **(p,n) reaction at intermediate energies.** Lind, D.A.; Masterson, T.; Sugarbaker, E.; Zafiratos, C.D. 1 Nov 1979.

In University of Colorado, Nuclear Physics Laboratory technical progress report, November 1, 1978-October 31, 1979.

The experimental angular distribution for the $^{13}C(p,n)^{13}N$ reaction at 120 MeV is shown, along with results of a DWBA calculation. A sample TOF spectrum from the $^{26}Mg(p,n)^{26}Al$ reaction at 120 MeV is exhibited, and the relative strengths of spin-isospin and isospin terms of the effective nucleon-nucleus interaction are extracted. 0° TOF spectra for $^{116}Sn(p,n)$ and $^{208}Pb(p,n)$ reactions are also given; concentration of strength above the IAS is noted in the former. 4 figures. (RWR)

19773 (DOE/ER/01388—807) **Summary of Kaon Factory Workshop.** Henley, E.M. (Washington Univ., Seattle (USA). Dept. of Physics). Aug 1979. Contract EY-76-C-06-1388. 11p. (RLO—1388-807; CONF-790847—16). Dep. NTIS, PC A02/MF A01.

From International conference on high energy physics and nuclear structure; Vancouver, Canada (13 Aug 1979).

Some highlights of the physics sessions of the Kaon Factory Workshop held in connection with the 8th International Conference on High-Energy Physics and Nuclear Structure in British Columbia in 1979 are presented. Particular emphasis is placed on the different investigations that can be carried out with kaons and antiprotons as opposed to pions and protons. Some data on $K + {}^{12}C$ elastic scattering are shown. 3 figures.

19774 (ORO—5224-3, pp 5-14) **Pion double charge exchange.** Dec 1979.

In Research in experimental nuclear physics. Progress report, April 1, 1979-March 31, 1980.

Double pion-exchange on O and Mg isotopes was investigated. Peaks were observed for both the double isobaric analog state (g.s., 0^+) and the first excited state (1.88 MeV, 2^+) in the reaction $^{18}O(\pi^+,\pi^-)^{18}Ne$ at 292 MeV. Also shown for this reaction are angular distributions at 291 and 164 MeV, along with excitation functions for $^{18}O(\pi^+,\pi^-)$ and $^{16}O(\pi^+,\pi^-)$ reactions from 80 to 290 MeV. A similar study yielded the angular distribution for $^{26}Mg(\pi^+,\pi^-)^{26}Si$ at 292 MeV and the excitation function for $^{26}Mg(\pi^+,\pi^-)$ and $^{24}Mg(\pi^+,\pi^-)$ reactions at 120 to 310 MeV. Transitions to the double isobaric analog state appear to dominate the reaction mechanism at pion energies substantially above the (3,3) resonance. 5 figures. (RWR)

19775 (ORO—5224-3, pp 15-29) **Isospin mixing in ^{12}C and ^{16}O.** Dec 1979.

In Research in experimental nuclear physics. Progress report, April 1, 1979-March 31, 1980.

Energy spectra from π^{+-} inelastic scattering from ^{12}C at 162 and 180 MeV and ^{16}O at 164 MeV are shown. A striking feature of 162-MeV scattering at high momentum transfer is strong excitation of a group of states near 19.5 MeV. A 4^- assignment is made. A doublet (18.35 and 19.35 MeV) with J/sup π/ = 2^- was also discovered in ^{12}C. Three-state mixing for known 4^- states (17.79, 18.98, and 19.80 MeV) in ^{16}O was seen. Some matrix elements were extracted. 4 figures. (RWR)

19776 (ORO—5224-3, pp 30-45) **Pion inelastic scattering reaction mechanism.** Dec 1979.

In Research in experimental nuclear physics. Progress report, April 1, 1979-March 31, 1980.

Extensive angular distributions for the $^{12}C(\pi^+,\pi^+)^{12}C^*$ reaction at 100 to 291 MeV to various excited states are shown, along with some excitation functions and optical-model calculations of $^{12}C(\pi^{+-},\pi^{+-})^{12}C$ angular distributions. Agreement between experimental data and DWIA calculations provides evidence for a simple, one-step reaction mechanism. 7 figures. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A = 20-38, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 19779

19777 **Optical potential for ^9Be scattering: another anomaly.** Satchler, G.R. (Oak Ridge National Lab., TN (USA)). *Phys. Lett., B;* **83**: No. 3-4, 284-288(21 May 1979).

Application of the same folding model which successfully reproduces the real ion-ion potential for other projectiles shows that the potential for ^9Be scattering is overestimated by a factor of two. This 'anomaly' is similar to that found for ^6Li.

NUCLEAR PROPERTIES AND REACTIONS, A = 20-38, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

19778 (ORO—5224-3, pp 54-58) **Mass measurements with pion double charge exchange (Texas, New Mexico State, LASL).** Dec 1979.

In Research in experimental nuclear physics. Progress report, April 1, 1979-March 31, 1980.

Ground-state masses of ^{12}O, ^{16}Ne, ^{24}Si, and ^{32}Ar, members of isospin quintets, were measured, and mass excesses are tabulated. Results were consistent with the quadratic nature of the isobaric multiplet mass equation. 2 tables. (RWR)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 19772, 19774

19779 (CONF-790348—7) **(p,n) reaction at intermediate energy.** Goodman, C.D. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 30p. Dep. NTIS, PC A03/MF A01.

From Conference on the p,n reaction and the nucleon-nucleon force; Telluride, CO, USA (29 Mar 1979).

The use of the (p,n) reaction in exploring effective interactions is reviewed. Some recent data on self-conjugate nuclei taken at the Indiana University Cyclotron Facility (IUCF) are presented, and the differences between low- and high-energy data are emphasized. Experimental problems and techniques used are briefly described. It is concluded that forward-angle (p,n) spectra at energies greater than 100 MeV are dominated by Gamow-Teller (GT) transitions, while Fermi transitions (IAS transitions) dominate near 45 MeV. Prominent GT transitions are expected from a pion-exchange interaction, and it is expected that OPEP is the dominant component of the interaction in the energy range of 100 to 200 MeV. 27 figures, 2 tables.

NUCLEAR PROPERTIES AND REACTIONS, A = 39-58, EXPERIMENTAL

REFER ALSO TO CITATION(S) 19777, 19802

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 19780

NUCLEAR REACTIONS AND SCATTERING

19780 (COO—535-767, pp 46-47) **$^{46,48}Ti$(p vector,α)$^{43,45}Sc$ reactions.** Boyd, R.N.; Donoghue, T.R.; Hausman, H.J.; Vigdor, S.; Schwandt, P.; Sugarbaker, E.; Fulbright, H.W. 1 Nov 1979.

In University of Colorado, Nuclear Physics Laboratory technical progress report, November 1, 1978-October 31, 1979.

Angular distributions and a few asymmetry points are shown for the $^{48}Ti(p,\alpha)$ reaction at 80 MeV along with results of cluster DWBA calculations. J/supπ/ assignments are made. 1 figure. (RWR)

19781 (COO—535-767, pp 53-55) **$^{58}Fe(^3He,t)$ (1^+) strength distribution.** Park, A.; Sugarbaker, E.; Emigh, R.A.; Fields, C.A.; Smith, P.A. 1 Nov 1979.

In University of Colorado, Nuclear Physics Laboratory technical progress report, November 1, 1978-October 31, 1979.

A sample spectrum from the reaction at 43 MeV is shown, and relative strengths are compared with those of other reactions exciting the same states. 1 figure, 1 table. (RWR)

19782 (ORO—5224-3, pp 46-53) **Quasielastic pion scattering (Texas, Virginia, New Mexico State, LASL).** Dec 1979.

In Research in experimental nuclear physics. Progress report, April 1, 1979-March 31, 1980.

Differential cross sections for π^{+-} scattering from ^{12}C, ^{40}Ca, ^{44}Ca, and ^{48}Ca were measured at 180 MeV (60°) and 291 MeV (60 and 120°). Many features of the data are reasonably well reproduced by a model of incoherent multiple scattering of pions by a Fermi gas of nucleons with a uniform, spherica distribution. 3 figures. (RWR)

19783 (ORO—5224-3, pp 59-62) **Pion inelastic scattering on $^{40,42,44,48}Ca$ and ^{54}Fe.** Dec 1979.

In Research in experimental nuclear physics. Progress report, April 1, 1979-March 31, 1980.

Differential cross sections were measured at 180 MeV incident energy. Effects of blocking and sum rule considerations are noted in the different cross sections for π^+ and π^-. 3 figures. (RWR)

19784 Coupled-channels effects in 0.8 GeV proton inelastic scattering from ^{58}Ni. Ray, L.; Kozlowski, T.; Madland, D.G.; Morris, C.L.; Pratt, J.C.; Spencer, J.E.; Tanaka, N.; Thiessen, H.A. (Los Alamos Scientific Lab., NM (USA)); Kyle, G.S.; Hintz, N.M. *Phys. Lett., B;* **83**: No. 3-4, 275-278(21 May 1979).

New differential cross sections for 0.8 GeV proton inelastic excitation of the first 2^+ and 4^+ states in ^{58}Ni are compared with distorted wave Born approximation and coupled-channels predictions. Multistep processes and multi-phonon mixing are both shown to be important in describing the excitation of the 4^+ state.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 19787

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 19789, 19806

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

RADIOACTIVE DECAY

19785 Half life of ^{132}Te. Dickens, J.K. (Oak Ridge National Lab., TN (USA)). *Radiochem. Radioanal. Lett.;* **39**: No. 2, 107-119(15 Jun 1979).

The half life of ^{132}Te has been measured by γ-ray spectroscopy. γ-ray spectra of fission product decay following thermal-neutron fission of ^{239}Pu were obtained for decay times between one and thirty days. Decay of the 228.2 keV γ-ray from ^{132}Te was analyzed to obtain the half life of ^{132}Te. The measured ^{132}Te half life was 76.29 +- 0.21 hr. Similar measurements were made for the 140.5 keV γ-ray from decay of ^{99}Mo, the 364.5 keV γ-ray from decay of ^{131}I, and 293.2 keV γ-ray from decay of ^{143}Ce. The half lives obtained were 66.16 +- 0.30 for ^{99}Mo, 191.93 + 1.34 hr for ^{131}I, and 33.31 +- 0.32 hr for ^{143}Ce.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 19788, 19790, 19791

19786 (COO—535-767, pp 82-84) **Level structure of ^{113}In.** Emigh, R.A.; Anderson, R.E.; Samuelson, L.E.; Fields, C.A. 1 Nov 1979.

In University of Colorado, Nuclear Physics Laboratory technical progress report, November 1, 1978-October 31, 1979.

Angular distribution coefficients for γ rays from the ^{109}Ag(α,nγ)^{112}In reaction at 16.4 MeV are tabulated. A partial level scheme with J/sup π/ assignments is given. The nuclear structure of ^{112}In is discussed briefly. 1 figure, 1 table. (RWR)

19787 (COO—535-767, pp 89-93) **Level structure of ^{90}Mo and ^{89}Mo.** de Boer, F.W.N.; Fields, C.A.; Ristinen, R.A.; Samuelson, L.E.; Smith, P.A. 1 Nov 1979.

In University of Colorado, Nuclear Physics Laboratory technical progress report, November 1, 1978-October 31, 1979.

Typical coincidence gamma spectra from the ^{90}Zr(^{3}He, 3nγ)^{90}Mo reaction at 33 MeV are shown. Level schemes obtained from this reaction (and the (^{3}He,4nγ) reaction) are presented and discussed. 3 figures. (RWR)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 19772, 19786, 19787

19788 (COO—535-767, pp 21-31) **Study of the $^{121\text{-}123}$Sb(p,d)$^{120\text{-}122}$Sb reactions.** Gartner, M.L.; Emigh. R.A.; Samuelson, L.E.; Smith, P.A. 1 Nov 1979.

In University of Colorado, Nuclear Physics Laboratory technical progress report, November 1, 1978-October 31, 1979.

Sample deuteron spectra and extensive angular distributions (with DW fits) from these reactions at 26.2 MeV are presented. States excited in these reactions, along with l-transfer and J/sup π/, are tabulated and briefly discussed. 12 figures, 2 tables. (RWR)

19789 (COO—535-767, pp 40-42) **Studies of the (t vector,p) reaction on medium-mass nuclei.** Alford, W.P.; Sugarbaker, E.; Boyd, R.N.; Flynn, E.R.; Brown, R.N.; Cizewski, J.; Hanson, D.; Sunier, J.; Ardouin, D. 1 Nov 1979.

In University of Colorado, Nuclear Physics Laboratory technical progress report, November 1, 1978-October 31, 1979.

Differential cross sections and analyzing powers were measured at 17 MeV for 10 targets with A = 56 to 126. Angular distributions and results of DWBA calculations are shown for ^{64}Ni, ^{96}Mo, ^{106}Pd, and ^{126}Te. 2 figures. (RWR)

19790 (COO—535-767, pp 49-53) **^{90}Zr(^{3}He,t)^{90}Nb reaction.** Fields, C.A.; Ristinen, R.A.; Samuelson, L.E.; Smith, P.A. 1 Nov 1979.

In University of Colorado, Nuclear Physics Laboratory technical progress report, November 1, 1978-October 31, 1979.

Experimental triton spectra and angular distributions from the ^{90}Zr(^{3}He,t)^{90}Nb reaction at 43.4 MeV are presented. The j dependence of the angular distributions enabled J/sup π/ assignments to be made. 3 figures, 1 table. (RWR)

19791 (COO—535-767, pp 85-89) **^{120}Sn(p,nγ)^{120}Sb reaction.** Emigh, R.A.; Samuelson, L.E.; Smith, P.A. 1 Nov 1979.

In University of Colorado, Nuclear Physics Laboratory technical progress report, November 1, 1978-October 31, 1979.

γ singles and coincidence spectra obtained near 5 MeV proton energy are shown. γ intenities and J/sup π/ assignments for initial and final states are tabulated. 3 figures, 1 tables. (RWR)

19792 Pion production with heavy ions. Landau, R.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.); Rasmussen, J.O. *Comments Nucl. Part. Phys.;* **9**: No. 1, 1-13(Aug 1979).

The results of studies of heavy ion reactions which involve pion production in the energy range approximately 0.4 - 2 GeV/nucleon are reviewed. The reasons for thinking that pion production studies should provide a sensitive test of the essential physics of nuclear collisions are outlined and the theoretical treatments of such collisions, considered. The subject is discussed under the following headings: experimental overview, multiplicities, single-particle spectra, cascade calculations, the kinematic limit, and interferometry in relativistic heavy - ion collisions. 32 references.

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

19793 (COO—535-767, pp 94-98) **Aligned octupole bands in deformed nuclei.** de Boer, F.W.N.; Fields, C.A.; Marro, G.; Smith, P.A.; Sugarbaker, E.; Konijn, J.; Verheul, H.; Walker, P.M. 1 Nov 1979.

In University of Colorado, Nuclear Physics Laboratory technical progress report, November 1, 1978-October 31, 1979.

Total spin is plotted vs angular momentum for the ground-state band (GSB) and negative-parity band (NPB) in ^{152}Sm and ^{156}Dy. Experimental GSB and NPB level energies for these nuclei are compared with results of a three-parameter variable-moment-of-inertia fit. 1 figure, 2 tables. (RWR)

19794 Single-proton states in ^{155}Eu. Burke, D.G. (McMaster Univ., Hamilton, Ontario (Canada). Tandem Accelerator Lab.); Lovhoiden, G.; Straume, O. (Bergen Univ. (Norway)); Flynn, E.R.; Sunier, J.W. (Los Alamos Scientific Lab., NM (USA)). *Can. J. Phys.;* **57**: No. 2, 271-285(Feb 1979).

The ^{156}Gd(t,α)^{155}Eu reaction was studied using 17 MeV polarized tritons from the tandem Van de Graaff accelerator at the Los Alamos Scientific Laboratory. The alpha particles were analyzed using a Q3D magnetic spectrometer and detected with a helical-cathode position-sensitive counter. The overall resolution was approximately 18 keV FWHM. Some additional exposures, performed using unpolarized tritons on a thinner target, had a resolution of approximately 12 keV FWHM and were helpful in the interpretation of a number of multiplets. Measurements of the ^{154}Sm(α,t)^{153}Eu reaction were made using 25 MeV alpha beams from the McMaster University tandem accelerator. The triton spectra were analyzed with a magnetic spectrograph using photographic emulsions for detectors, yielding a resolution of approximately 10 keV FWHM. By comparing the measured angular distributions of (t,α) cross sections and analyzing powers with DWBA predictions it was possible to assign spins and parities to many levels. The present results confirm earlier assignments of rotational bands based on the low-lying $5/2^+$ [413], $5/2^-$ [532], and $3/2^+$ [411] orbitals. In addition, states at higher excitation have now been assigned to the $1/2^+$ [411], $1/2^+$ [420], and $7/2^+$ [404] orbitals, and a $3/2^+$ [422] band is tentatively proposed. The spectroscopic strengths can be explained reasonably well by the Nilsson model when pairing and Coriolis mixing effects are included.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 19794

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL

REFER ALSO TO CITATION(S) 19777, 19795

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 19796

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 19772

19795 (COO—535-767, pp 18-20) **Two-step effects in the ^{208}Pb(d vector,t)^{207}Pb reaction.** Sugarbaker, E.; Alford, W.P.; Boyd, R.N.; Flynn, E.R.; Cameron, J.A. 1 Nov 1979.

In University of Colorado, Nuclear Physics Laboratory technical progress report, November 1, 1978-October 31, 1979.

Differential cross sections, analyzing powers, and tensor analyzing powers were measured from 10° to 60° at 17 MeV. Results of zero- and finite-range DWBA calculations are shown. One-step DWBA and two-step CCBA calculations of angular distributions for the 512$^+$ to 712$^+$ doublet at 2.6 MeV in ^{207}Pb were performed, and results are presented. 2 figures. (RWR)

19796 (COO—535-767, pp 32-37) **Two-nucleon transfer reactions.** Weiss, R.C.; Anderson, R.E.; Kraushaar, J.J.; Ristinen, R.A.; Shastry, S. 1 Nov 1979.

In University of Colorado, Nuclear Physics Laboratory technical progress report, November 1, 1978-October 31, 1979.

Spectra taken for the ^{208}Pb, ^{206}Pb, ^{205}Tl(p,t) reactions at 26.2 MeV are shown. Then angular distributions and zero-range DWBA calculations for 36 states in ^{203}Tl are presented. Levels in ^{203}Tl and ^{204}Pb are given with spin-parity assignment and compared with results of theoretical calculations. 4 figures, 1 table. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

19797 **Effect of the spin-orbit potential on the single particle levels in the superheavy region.** Tanaka, Y.; Oda, Y. (Tokyo Inst. of Tech. (Japan). Dept. of Physics); Petrovich, F.; Sheline, R.K. (Florida State Univ., Tallahassee (USA). Dept. of Physics). *Phys. Lett., B;* **83**: No. 3-4, 279-283(21 May 1979).

A new potential fit to single particle levels in doubly closed shell nuclei from ^{16}O to ^{208}Pb is presented and the effect of a negative spin-orbit symmetry term on the single particle levels in the superheavy region is discussed.

NUCLEAR THEORY

REFER ALSO TO CITATION(S) 19760

NUCLEAR REACTIONS AND SCATTERING

19798 (CONF-780857—4) **Multi-step direct reaction analysis of deep inelastic spectra in nuclear reactions.** Tamura, T.; Udagawa, T. (Texas Univ., Austin (USA). Dept. of Physics). 1978. Contract EY-76-C-05-2972. 33p. Dep. NTIS, PC A03/MF A01.

From Conference on dynamical properties of heavy-ion reactions; Johannesburg, South Africa (1 Aug 1978).

Application of direct reaction theories in the past has been limited to reactions with discrete final states. These lecture notes show that the applications can be extended to data with continuous spectra as well. Examples of analyses of data of reactions induced by both light and heavy ions are discussed. The latter application is limited so far to examples with comparatively light heavy ions. The scope of its extension to cases with heavier projectiles is also discussed. 5 figures.

19799 (CONF-800337—1) **Nuclear momentum distribution and relativistic heavy-ion reactions.** Wong, C.Y.; Blankenbecler, R. (Oak Ridge National Lab., TN (USA); Stanford Linear Accelerator Center, CA (USA)). 1980. Contract W-7405-ENG-26. 4p. Dep. NTIS, PC A02/MF A01.

From Winter workshop on nuclear dynamics; Lake Tahoe, NV, USA (17 Mar 1980).

In terms of a direction fragmentation process and a hard-scattering process, the proton-inclusive data for the reaction $\alpha + {}^{12}C \rightarrow p + X$ were successfully analyzed. The extracted semiempirical momentum distribution indicates possible evidence of nuclear correlations and final-state interactions. 4 figures.

19800 (CONF-800337—2) **Scaling phenomenon in relativistic nucleus-nucleus collisions.** Wong, C.Y.; Blankenbecler, R. (Oak Ridge National Lab., TN (USA); Stanford Linear Accelerator Center, CA (USA)). 1980. Contract W-7405-ENG-26. 4p. Dep. NTIS, PC A02/MF A01.

From Winter workshop on nuclear dynamics; Lake Tahoe, NV, USA (17 Mar 1980).

New scaling variables for proton and pion production in relativistic nucleus-nucleus collisions are introduced which are the generalizations of the Feynmann scaling variable. They allow a simple description of the cross sections at forward and backward angles. 2 figures.

19801 (DOE/TIC—11150) **Multi-step-direct-reaction theory applied to continuum spectra in light- and heavy-ion induced reactions.** Tamura, T. (Texas Univ., Austin (USA). Dept. of Physics). Nov 1978. Contract EY-76-C-05-2972. 10p. Dep. NTIS, PC A02/MF A01.

Results of applying multistep direct reaction theory to reactions induced by p, ^{14}N, ^{19}F, and ^{20}Ne are illustrated with angular distributions and energy spectra. The data and concepts have already been (or will be) published in the usual places. (RWR)

19802 **Angular momentum and binding energy effects in two-nucleon transfer.** Vallieres, M. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Physics); Feng, D.H. (Drexel Univ., Philadelphia, PA (USA)); Pinkston, W.T. (Vanderbilt Univ., Nashville, TN (USA)). *Phys. Lett., B;* **83**: No. 3-4, 267-270(21 May 1979).

Results of large-basis shell-model calculations of two-nucleon transfer overlaps are presented for non-zero angular momentum and for nn, np and pp systems such as ^{42}Ca, ^{42}Sc, ^{42}Ti which have very different binding energies. It is shown that the usual well-depth method underestimates the two-nucleon transfer overlaps for tightly bound systems but over-estimates these overlaps for the weakly bound systems. The differential cross sections can also be distorted by the well-depth method in some particular cases.

NUCLEAR MODELS

REFER ALSO TO CITATION(S) 19777, 19797

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

19803 (UCRL—84021) **Multiple-line thermal blooming, strong t^3-blooming, and phase compensation calculations with FOUR-D.** Morris, J.R.; Fleck, J.A. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1980. Contract W-7405-ENG-48. 46p. (CONF-800338—1). Dep. NTIS, PC A03/MF A01.

From High energy laser propagation adaptive optics meeting; Redstone Arsenal, AL, USA (19 Mar 1980).

FOUR-D's steady-state multiple-line mode was used to evaluate a power-weighted-average model of NACL beam propagation. Five NACL lines were propagated with separate intensity, phase, wavelength, and absorption coefficient. The on-target areas obtained from a power-weighted average model were up to 36% smaller than the corresponding multiple-line model areas. The maximum difference occurred for pure diffraction and decreased as thermal blooming was increased. The FOUR-D strong t^3-blooming model combines an exact solution of the linearized hydrodynamic equations with a steady-state model of overlap blooming. Propagation of a focused high-power multipulse laser beam with a uniformity illuminated square aperture demonstrates the generality of this model. In the examples, the square beam outperformed the Gaussian beam by 20 to 40% in peak intensity, 55 to 80% in half-power area. The contribution of t^3-blooming to the on-target area was decreased by overlap blooming for the Gaussian beam, but increased for the square beam. Two of FOUR-D's three models of phase compensation for steady-state thermal blooming - an effective thin lens and return wave - will also be discussed.

NEUTRON INTERACTIONS WITH MATTER

REFER ALSO TO CITATION(S) 19254

19804 (IS-M—221) **Field induced magnetic form factor of Zr.** Stassis, C.; Kline, G.; Harmon, B.N.; Moon, R.M.; Koehler, W.C. (Ames Lab., IA (USA); Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Physics; Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-82. 10p. (CONF-790909—17). Dep. NTIS, PC A02/MF A01.

From International conference on magnetism; Munich, F.R. Germany (Sep 1979).

The neutron magnetic form factor obtained with H perpendicular to the c-axis is in good agreement with calculations assuming a 65% band theoretical spin density and a 35% atomic-like orbital

density. Measurements with two different field directions showed no evidence of the large anisotropy observed in bulk susceptibility experiments.

19805 Maximum density and capture rate of neutrons moderated from a pulsed source. Baldwin, G.C.; Solem, J.C. (Univ. of California, Los Alamos, NM). *Nucl. Sci. Eng.;* **72**: No. 3, 281-289(Dec 1979).

Upper bounds are shown to exist on the density of neutrons that can be moderated to a specified energy from an intense pulsed source of fast neutrons. Expressions are derived for the maximum density in the following cases: (a) a uniform injection of fast neutrons into an infinite moderator; (b) a localized central source in a finite heavy atom moderator; and (c) a point source in an infinite hydrogenous moderator. Correspondingly, upper bounds are given for the rates of single- and multiple-resonance neutron capture.

19806 Interaction of fast neutrons with Nickel-60. Smith, A.; Guenther, P.; Smith, D.; Whalen, J. (Argonne National Lab., IL). *Nucl. Sci. Eng.;* **72**: No. 3, 293-303(Dec 1979).

Neutron total cross sections of ^{60}Ni were measured with broad resolution from ~ 0.5 to 5.0 MeV at intervals of ≦ 50 keV. Differential elastic neutron scattering cross sections were measured from 1.5 to 4.0 MeV at intervals of ≦ 50 keV over the scattered neutron angular range from ~ 20 to 160°. Differential cross sections for the inelastic neutron excitation of states at 1.342 +- 0.013, 2.168 +- 0.012, 2.304 +- 0.026, 2.509 +- 0.022, 2.636 +- 0.019, and 3.164 +- 0.041 MeV were also measured. The experimental results are interpreted in terms of optical-statistical and coupled-channel models, including consideration of compound nucleus fluctuations and direct-vibrational processes.

MEDICAL PHYSICS

DOSIMETRY

19807 Low-energy electron LET and range in soft biological tissue, DNA, water and polyethylene. Kalugina, I.K.; Savinskii, A.K.; Chernova, O.N. *Radiobiology (USSR) (Engl. Transl.);* **19**: No. 1, 108-112(Oct 1979).

Translated from Radiobiologiya; 19: No. 1, 96-99(1979).

Linear energy transfer (LET) and range of electrons in various tissue-equivalent media (DNA, water, and polyethylene) in the energy range of 10 eV to 100 keV, which is referable to most of the spectrum of degradation of secondary electrons of x radiation and delta electrons of heavy charged particles, were investigated. Stopping power of hydrogen, carbon, nitrogen, and oxygen for electrons with different energy was discussed.

SOLID STATE PHYSICS

REFER ALSO TO CITATION(S) 18561, 18569

19808 (IS-M—220) Spin waves in static non-periodic structures. Liu, S.H. (Ames Lab., IA (USA)). 1979. Contract W-7405-ENG-82. 7p. (CONF-790909—16). Dep. NTIS, PC A02/MF A01.

From International conference on magnetism; Munich, F.R. Germany (Sep 1979).

The motion of spin waves in a disordered magnetic system is equivalent to that of a particle in a random potential, which is determined by how rapidly the spin structure evolves in space. The frequency softens according to the average of the potential, and the momentum width depends on the spatial correlation function of the potential.

THEORETICAL PHYSICS

CLASSICAL AND QUANTUM MECHANICS

19809 Computer modeling of quantum liquids and crystals. Kalos, M.H.; Whitlock, P.A.; Ceperley, D.M. (Courant Inst. of Mathematical Sciences, New York, NY). *ACS Symp. Ser.;* No. 86, 219-230(1978).

There are a number of many-body systems which exhibit quantum effects on a macroscopic scale. These include liquid and crystal states of both He-3 and He-4, the electron gas, and neutron matter which probably constitutes the interior of pulsors. In addition, nuclear matter - a hypothetical extensive system of nucleons has been studied for the insight one may gain into the nature of finite nuclei. The theoretical studies of these systems have by now a long history but are by no means concluded. In the last few years, significant advances have been made. This has come in part from the maturity of and gradual unification of many-body theory, in part from the development and application of powerful new expansion procedures, especially varieties of hypernetted-chain equations, and finally to the growing power of computer simulation methods for quantum systems. This article is intended as a review of some recent development in computational methods for extensive quantum systems, and of the relation between results so obtained to the evolution of other theoretical work.

19810 Time-dependent correlations for the anisotropic Heisenberg model. Dekeyser, R. (Univ., Louvain, Belgium); Lee, M.H. pp 748-751 of Annals of Israel Physical Society. Volume 2. Cabib, D.; Kuper, C.; Riess, I. (eds.). Jerusalem, Israel; Israel Physical Society (1978).

From 13. international conference on statistical physics; Haifa, Israel (24 Aug 1978).

The time-dependent autocorrelation function has been calculated for the x-component of the total spin in a spin 1/2 XY-model with (weak) coupling between the z-components, for the high-density limit. The decay in time is Gaussian, with a width depending on temperature and anisotropy, but continuous through the critical point. This is compared with the results obtained for the one-dimensional XY-model at high temperatures.

ELECTRICITY AND MAGNETISM

REFER ALSO TO CITATION(S) 19273

19811 (UCID—18590) Pattern synthesis using pole-zero modeling. Miller, E.K.; Lager, D.L.; Okada, J.T.; Burke, G.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Mar 1980. Contract W-7405-ENG-48. 44p. Dep. NTIS, PC A03/MF A01.

A procedure for synthesizing line-source radiation patterns based on pole-zero modeling (Prony's method) is outlined, and its application to various specified patterns is demonstrated. The most significant property of the techniques is that it requires no a priori selection of either array length or source spacing. Both are provided, together with the source strengths, from the pole-zero model. Only the number of sources (or poles) and the pattern to be synthesized need be specified by the user. Several issues related to using the technique are also discussed. 10 figures.

MATHEMATICAL PHYSICS

19812 (ORNL/CSD/TM—117) Implementing sparse matrix techniques in the ERATO code. Scott, D.S. (Union Carbide Corp., Oak Ridge, TN (USA). Computer Sciences Div.). Apr 1980. Contract W-7405-ENG-26. 29p. Dep. NTIS, PC A03/MF A01.

The ERATO code computes the stability of an equilibrium with respect to the linear MHD equation. The ERATO code is divided into 5 programs (ERATO1 through ERATO5). This report documents some minor changes made in ERATO3 and a major reorganization of ERATO4. The changes were made to reduce drastically the amount of secondary storage needed by the codes and at the same time improve the efficiency of ERATO4. The ultimate goal is to allow the successful completion of runs with finer meshes than are currently possible. ERATO4 takes given matrices, A and B, and a shift parameter, ω_0, and computes the Choleski factorization (U/sup T/DU) of the matrix A - ω_0B. It then uses the factorization to implement inverse iteration to find the eigenvalue of the generalized eigenvalue problem A - lambda B closest to ω_0 and its corresponding eigenvector. The matrices A and B are highly structured and quite sparse. Both are symmetric and B is positive definite. Each block consists of 16 square subblocks. 9 figures. (RWR)

FUSION ENERGY

REFER ALSO TO CITATION(S) 19128

PLASMA RESEARCH

PLASMA CONFINEMENT AND HEATING

19813 (ORNL/TM—7064) Electron cyclotron heating rate and cavity Q estimations for an EBT plasma. Uckan, T. (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 44p. Dep. NTIS, PC A03/MF A01.

The perpendicular energy gain ΔW/sub perpendicular to/ of electrons from the applied extraordinary microwave field in ELMO Bumpy Torus (EBT) is calculated by means of the stochastic model for the field-plasma cyclotron resonance interactions. In these calculations an inhomogeneous bumpy magnetic field is chosen in order to simulate the field strength of the EBT as well as to include the effects of mirror trapping. The effects of the initial energy of the

electrons and the value of the mirror ratio on the trapping are discussed, and the heating rate ΔW/sub perpendicular to//Δt (where Δt is the reflection time from the mirror) is estimated. The loaded cavity quality factor Q/sub L/ is then expressed from the heating rate, the result is applied to the EBT-I plasma, and a value of Q/sub L/ ≅ 15 is found.

19814 (PPPL—1642) **Generation of ponderomotive craters during high power microwave irradiation of plasma.** Motley, R.W.; Hooke, W.M.; Gwinn, C.R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1980. Contract EY-76-C-02-3073. 16p. Dep. NTIS, PC A02/MF A01.

Localized plasma density depressions or craters are observed to form near the mouth of a phased waveguide array, if the power flux exceeds ~ 0.3 kW/cm².

19815 (SAND—80-0608C) **Plasma density profiles and finite bandwidth effects on electron heating.** Spielman, R.B.; Mizuno, K.; DeGroot, J.S.; Bollen, W.M.; Woo, W. (California Univ., Davis (USA). Dept. of Applied Science). 1980. Contract EY-76-C-04-0789. 8p. (CONF-800418—2). Dep. NTIS, PC A02/MF A01.

From Joint conference of the 4th Kiev international conference on plasma theory and 4th congress on waves and instabilities in plasma; Nagoya, Japan (15 Apr 1980).

Intense, p-polarized microwaves are incident on an inhomogeneous plasma in a cylindrical waveguide. Microwaves are mainly absorbed by resonant absorption near the critical surface (where the plasma frequency, ω/sub pe/, equals the microwave frequency, ω/sub o/). The localized plasma waves strongly modify the plasma density. Step-plateau density profiles or a cavity are created depending on the plasma flow speed. Hot electron production is strongly affected by the microwave bandwidth. The hot electron temperature varies as T/sub H/ is proportional to $(\Delta\ \omega/\omega)^{-0.25}$. As the hot electron temperature decreases with increasing driver bandwidth, the hot electron density increases. This increase is such that the heat flux into the overdense region (Q is proportional to eta/sub H/T/sub H/$^{(3/2)}$) is nearly constant.

19816 (SAND—80-0609C) **Electron heating due to resonant absorption.** Mizuno, K.; Spielman, R.B.; DeGroot, J.S.; Bollen, W.M. (California Univ., Davis (USA). Dept. of Applied Science). 1980. Contract EY-76-C-04-0789. 8p. (CONF-800418—1). Dep. NTIS, PC A02/MF A01.

From Joint conference of the 4th Kiev international conference on plasma theory and 4th congress on waves and instabilities in plasma; Nagoya, Japan (15 Apr 1980).

Intense, p-polarized microwaves (v/sub os//v/sub eo-/<1) are incident on an imhomogeneous plasma (10^2<L/λ/sub Deo-/<10^3) in the UC Davis PROMETHEUS I device. Microwaves are mainly absorbed by resonant absorption near the critical surface (where the plasma frequency equals microwave frequency). Suprathermal electrons are heated by resonantly driven electrostatic field to produce a hot Maxwellian distribution. Most of the heated electrons flow towards the overdense region and are absorbed by the anode at the far end of the overdense region. At high power (v/sub os//v/sub eo-/>0.2), strong heating of thermal electrons, large amplitude ion acoustic turbulence, and a self-consistent dc electric field are observed near the critical surface. This dc electric field is enhanced by applying a weak magnetic field (ω/sub ce//ω/sub o/ ≅ 10^{-2}).

19817 (UCID—18579) **Adiabatic compression and radiative compression of magnetic fields.** Woods, C.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Feb 1980. Contract W-7405-ENG-48. 19p. Dep. NTIS, PC A02/MF A01.

Flux is conserved during mechanical compression of magnetic fields for both nonrelativistic and relativistic compressors. However, the relativistic compressor generates radiation, which can carry up to twice the energy content of the magnetic field compressed adiabatically. The radiation may be either confined or allowed to escape.

19818 **High beta plasmas in toroidal surmacs.** Schumacher, R.W. Los Angeles, CA; University of California (1979). 261p. University Microfilms Order No. 79-15,679.

Thesis (Ph. D.).

This work addresses the physics problems encountered in developing high order, toroidal multipole plasma confinement devices into fusion reactors. The high order configuration, termed Surmac for Surface Magnetic Confinement, is generated by internal current-carrying rings which produce closed, axisymmetric surface magnetic fields. Plasma is stabilized and confined by the deep magnetic well enclosed by the surface fields.

PLASMA DIAGNOSTICS

19819 (CONF-800320—2) **Analysis of Mirnov signals from coils mounted in a rectangular array.** Navarro, A.P.; Dunlap, J.L.; Pare, V.K.; Burris, R.D. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 21p. Dep. NTIS, PC A02/MF A01.

From 3. topical conference on high temperature plasma diagnostics; Los Angeles, CA, USA (17 Mar 1980).

Data analysis techniques for determining the structure of MHD instabilities in the ISX-B tokamak from Mirnov signals have been under development. Standard techniques cannot be applied directly in this case since the rectangular shape of the vacuum chamber requires a similar shape for the poloidal array of magnetic pickup coils. Components of the poloidal field perturbation are considered both parallel and perpendicular to the chamber walls and a twofold problem is addressed: (a) determining the relative signal phases as a function of poloidal angle along the array for any particular poloidal structure of plasma perturbation, without boundary effects; and (b) determining distortions of these phase lines due to eddy currents in the chamber. Results from simulation of plasma perturbations and from ISX-B experimental data are discussed.

19820 (ORNL/TM—7054) **Recent improvements in Thomson scattering data analysis.** Tillack, M.S.; Lazarus, E.A. (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 59p. Dep. NTIS, PC A04/MF A01.

A new profile analysis package for use with the Thomson scattering data on ISX-B has recently been implemented. The primary feature of this package is a weighted least squares fitting of temperature and density data to generate a representative curve, as opposed to the previous hand-fitting technique. The changes will automate the manner in which data are transmitted and manipulated, without affecting the calculational techniques previously used. The computer programs have also been used to estimate the sensitivity of various plasma quantities to the accuracy of the Thomson scattering data.

19821 (ORNL/TM—7168) **Ray tracing package through a lens system and a spectrometer.** Zurro, B.; King, P.W.; Lazarus, E.A. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 30p. Dep. NTIS, PC A03/MF A01.

To study the light collection optics of the ISX-B two-dimensional (2-D) Thomson scattering system, we have implemented in the Oak Ridge National Laboratory (ORNL) Fusion Energy Division (FED) PDP-10 two computer programs, LENS and SPECT, that trace rays through a lens system and a spectrometer, respectively. The lens package follows the path of any kind of ray (meridional or skew) through a centered optical system formed by an arbitrary number of spherical surfaces. The spectrometer package performs geometrical ray tracing through a Czerney-Turner spectrometer and can be easily modified for studying any other configuration. Contained herein is a description of the procedures followed and a listing of the computer programs.

19822 **Temperature measurement in the Tormac IV-C plasma.** Greenwald, M.J. Berkeley, CA; University of California (1978). 152p. University Microfilms Order No. 79-14,622.

Thesis (Ph. D.).

A magnetic confinement device TORMAC IV-c, was built to test the Tormac concept and the results of TORMAC IV-a. The new device had improved access for diagnostics, particularly for laser scattering and He-Ne interferometry. The results were disappointing; measured electron temperatures were consistently in the neighborhood of 5 eV. Peak densities were 5 to 8 x 10^{15}/cm³. Under these highly collisional conditions, no conclusions about Tormac confinement could be drawn.

PLASMA KINETICS - EXPERIMENTAL

19823 **Extreme ultraviolet diagnosis of a neutral-beam-heated mirror machine.** Drake, R.P. Baltimore, MD; Johns Hopkins University (1979). 234p. University Microfilms Order No. 79-14,284.

Thesis (Ph. D.).

Extreme ultraviolet emissions from the 2XIIB fusion research experiment have been studied. 2XIIB was a magnetic-mirror-plasma-confinement device; beams of high energy (20 keV) neutral deuterium created a high density, high temperature plasma. A normal-incidence concave-grating monochromator, equipped with a windowless photomultiplier tube, was used to measure emissions in the spectral region from 400 A to 1600 A. Emissions of oxygen, titanium, carbon, nitrogen, and deuterium were identified; the oxygen brightnesses at times exceeded 10^{18} ph-sec^{-1}-cm^{-2}-sr^{-1}. A survey of the emission characteristics was performed. The oxygen concentration was found to be 3%; the other impurities had concentrations near 0.4%. The radiated power loss was about 5% of the deposited neutral beam power.

19824 **euv study of impurities in the Alcator A Tokamak.** Chen, K. Baltimore, MD; Johns Hopkins University (1979). 117p. University Microfilms Order No. 79-14,279.

Thesis (Ph. D.).

A photometrically calibrated 0.4 m normal incidence euv monochromator (wavelength range 300 A to 1700 A) has been utilized to study impurities spectroscopically in the Alcator A Tokamak. Light impurities (O, N, C) and heavy impurities (Mo, Fe, Cr) in

Alcator A have been identified by the euv emissions from these ions. Besides temporal profiles of all the impurities, the spatial profiles of O VI, O V and N V have also been obtained by tilting the monochromator to scan the plasma. The effects of wall temperature on light impurity concentrations in the Alcator A Tokamak have been measured spectroscopically. The results show that a temperature reduction decreases the influx of oxygen by a factor of 4 ~ 5 in normal tokamak operation when the wall temperature dropped from 450°K to 77°K but does not affect the other light impurities (N, C).

PLASMA KINETICS - THEORETICAL

REFER ALSO TO CITATION(S) 18870

19825 (ORNL/TM—7146) **ZORNOC: a 1 1/2-D tokamak data analysis code for studying noncircular high beta plasmas.** Zurro, B.; Wieland, R.M.; Murakami, M.; Swain, D.W. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 42p. Dep. NTIS, PC A03/MF A01.

A new tokamak data analysis code, ZORNOC, was developed to study noncircular, high beta plasmas in the Impurity Study Experiment (ISX-B). These plasmas exhibit significant flux surface shifts and elongation in both ohmically heated and beam-heated discharges. The MHD equilibrium flux surface geometry is determined by solving the Grad-Shafranov equation based on: (1) the shape of the outermost flux surface, deduced from the magnetic loop probes; (2) a pressure profile, deduced by means of Thomson scattering data (electrons), charge exchange data (ions), and a Fokker-Planck model (fast ions); and (3) a safety factor profile, determined from the experimental data using a simple model (Z/sub eff/ = const) that is self-consistently altered while the plasma equilibrium is iterated. For beam-heated discharches the beam deposition profile is determined by means of a Monte Carlo scheme and the slowing down of the fast ions by means of an analytical solution of the Fokker-Planck equation. The code also carries out an electron power balance and calculates various confinement parameters. The code is described and examples of its operation are given.

19826 (PPPL—1648) **Time rate collision matrix.** Stoenescu, M.L.; Smith, T.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Feb 1980. Contract EY-76-C-02-3073. 44p. Dep. NTIS, PC A03/MF A01.

The collision integral terms in Boltzmann equation are reformulated numerically leading to the substitution of the multiple integrals with a multiplicative matrix of the two colliding species velocity distribution functions which varies with the differential collision cross section. A matrix of lower rank may be constructed when one of the distribution functions is specified, in which case the matrix elements represent kinetic transition probabilities in the velocity space and the multiplication of the time rate collision matrix with the unknown velocity distribution function expresses the time rate of change of the distribution. The collision matrix may be used to describe the time evolution of systems in nonequilibrium conditions, to evaluate the rate of momentum and energy transfer between given species, or to generate validity criteria for linearized kinetic equations.

19827 (WFPS-TME—79-030) **Performance analyses of Elmo Bumpy Torus plasmas and plasma support systems.** Fenstermacher, M.E. (Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering; Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). 31 Dec 1979. Contract EG-77-C-02-4231. 110p. Dep. NTIS, PC A06/MF A01.

The development and applcation of the OASIS Code (Operational Analysis of ELMO Bumpy Torus Support and Ignition Systems) for the study of EBT device and plasma performance are presented. The code performs a time-independent, zero-dimensional self-consistent calculation of plasma and plasmasupport systems parameters for the physics and engineering of EBT devices. The features of OASIS modeling for the EBT plasma include: (1) particle balance of the bulk toroidal and electron ring plasma components for experimental (H-H, D-D, He-He etc.) as well as reactor (D-T) devices; (2) energy balance in the bulk and ring plasmas for externally heated or ignition devices; (3) alpha particle effects for reactor devices; (4) auxiliary heating effects, including microwave (ECRH), RF heating (e.g., ICRH), and neutral beam methods; and (5) ignition conditions, including fusion power, alpha power and neutron wall loading. The performance studies using OASIS focussed on variation in plasma and device size and on microwave input power and frequency. An additional study was performed to determine the characteristics of an EBT reactor proof-of-principle device operated with a deuterium-tritium plasma. Sensitivity studies were performed for variation in the input microwave power sharing fractions and the dependence of the bulk n tau scaling law on bulk electron temperature.

19828 **Effects of suprathermal fusion particles in tokamak plasmas.** Petrie, T.W. Urbana, IL; Universiy of Illinois (1978). 156p. University Microfilms Order No. 79-13,575.

Thesis (Ph. D.).

Several crucial properties of suprathermal (> 500 keV) fusion-products are explored, both in their initial phase and during their slowing-down period. A guiding center drift theory, which predicts the effect of energy loss on the motion of these suprathermals, is derived for a low-β, symmetric (non-ripple) tokamak. Velocity-space scattering is ignored. Among the important implications of this theory are: (1) the net inward drift of fusion particles during their slow-down phase, and (2) the importance of the plasma density and temperature in determining this drift.

19829 **Numerical solution of the axisymmetric magnetothydrodynamic equilibrium equation.** Reusch, M.F. New York, NY; Columbia University (1976). 147p. University Microfilms Order No. 78-19,418.

Thesis (Ph. D.).

The Dirichlet problem for this elliptic, mildly nonlinear, partial differential equation, in a finite domain of solution is studied. Conditions for the existence and uniqueness of solutions to this problem are discussed. A lower bound on a parameter in the equation, below which bifurcation cannot occur, is derived. The behavior of a simple type of solution is analyzed. Several iteration methods for the numerical solution of the problem, one of them originated by the author, are presented and their convergence discussed. A fixed minimum constraint method for the numerical solution is analyzed. Several iteration methods for the numerical solution of the problem, one of them originated by the author, are presented and their convergence discussed. A fixed minimum constraint method for consistently finding several nonunique solutions to the problem is given. A one point approximation estimate is developed for the prediction of the occurrence of nonuniqueness and the number of nonunique solutions. A 1-D model problem, which is nonunique and exactly soluble, and for which a numerical iteration procedure is also soluble at every stage, is discussed in detail. The results of the numerical solution of the problem are presented for several choices of pressure and toroidal field profiles.

PLASMA INSTABILITIES

19830 **Stability of the critical surface in the presence of strong electromagnetic radiation.** Woo, W.Y. Davis, CA; University of California (1978). 157p. University Microfilms Order No. 79-12,985.

Thesis (Ph. D.).

The stability of critical surface of a semi-infinite plasma supported by strong incoming light is investigated theoretically with one and two dimensional computer fluid calculations for s- and p-polarized light. In s-polarization electromagnetic instabilities occur because only electromagnetic waves are allowed in the system, whereas the p-polarization electrostatic instabilities dominate. The instabilities are mainly oscillating two stream type with both Stokes and anti-Stokes components being excited. The self-consistency of the high frequency field structure and the plasma density profile is treated by combining the pump size and the length of density gradient as one dependent parameter, and hence the thresholds obtained do not vary as 1/k as predicted previously.

19831 (PPPL—1601) **Ion-temperature-gradient instability in toroidal plasmas.** Guzdar, P.N.; Chen, L.; Tang, W.M.; Rutherford, P.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1980. Contract EY-76-C-02-3073. 43p. Dep. NTIS, PC A03/MF A01.

The stability of the ion-temperature-gradient mode in a toroidal plasma is investigated. Using the ballooning-mode formalism, an ordinary difference-differential equation is derived which includes full kinetic effects. The equation is, then, examined in various limits where it reduces to an ordinary differential equation. Analytic and computational studies show that, for eta/sub i/ identical with d lnT/sub i//d lnn > 1, toroidal effects further destabilize the mode and, hence, the corresponding growth rates exceed those obtained from the slab calculations. However, it is also found that toroidal effects give rise to higher eta/sub i/ threshold compared to the slab case. Extensive numerical calculations over a wide range of parameters are carried out to delineate the regions of instability. It is concluded that the eta/sub i/ instability is of relevance to present-day beam heated tokamaks.

19832 (PPPL—1628) **Effects of multiple ion species on two-dimensional trapped-electron modes.** Rewoldt, G.; Tang, W.M.; Frieman, E.A. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1980. Contract EY-76-C-02-3073. 28p. Dep. NTIS, PC A03/MF A01.

Previous calculations for the two-dimensional spatial structure of drift and trapped-electron modes in tokamaks are generalized to include an arbitrary number of ion species. Thus, it is possible to determine the influence of light or heavy impurity ions, and of multiple hydrogen isotopes, on these instabilities. As an example, results are presented for the case of a single light impurity species.

Here the effect is found to be either stabilizing or destabilizing, depending on specific parameters, such as the equilibrium density profiles. Moreover, if a sufficiently idealized model is adopted, beam ion effects can also be studied. In the case considered, corresponding to the neutral-beam-heated PLT, these effects are found to be stabilizing.

19833 (PPPL—1645) **Passive stabilization in a linear MHD stability code.** Todd, A.M.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1980. Contract EY-76-C-02-3073. 23p. Dep. NTIS, PC A02/MF A01.

Utilizing a Galerkin procedure to calculate the vacuum contribution to the ideal MHD Lagrangian, the implementation of realistic boundary conditions are described in a linear stability code. The procedure permits calculation of the effect of arbitrary conducting structure on ideal MHD instabilities, as opposed to the prior use of an encircling shell. The passive stabilization of conducting coils on the tokamak vertical instability is calculated within the PEST code and gives excellent agreement with 2-D time dependent simulations of PDX.

19834 Axial feedback stabilization of the flute instability in mirror plasmas. Wong, S.L. Berkeley, CA; University of California (1978). 90p. University Microfilms Order No. 79-14,816.

Thesis (Ph. D.).

The flute mode in a mirror-confined plasma is stabilized by modifying the line-tying admittance between the bulk of the plasma and the end wall with feedback. By feeding back a voltage proportional to the time integral of the potential perturbation, stabilization is obtained for individual modes. The axial feedback concept is extended to two other feedback schemes: proportional feedback, and proportional-and-derivative feedback. The integral feedback scheme is used to stabilize the $p = 1$ flute mode in a seven cell multiple mirror plasma. A systems analysis of the experimental set-up is performed and a coupled-mode feedback theory is developed for the experimental system. There is good qualitative agreement between experiment and theory. Phase shifts due to mode coupling are observed. By using a mode filter in the feedback loop to reduce mode coupling, a reduction in phase shift as well as an expansion in the stabilization region are observed, in agreement with the coupled mode theory. Some preliminary results on the dynamic stabilization of the flute instability, using charges injected axially from a segmented end wall, are presented.

19835 Experimental investigation of stability in a high energy plasma confined by a simple magnetic mirror field (MIGMA). Treglio, J.R. Hoboken, NJ; Stevens Institute of Technology (1977). 166p. University Microfilms Order No. 78-21,636.

Thesis (Ph. D.).

A plasma, formed by direct injection of 1.1 to 1.25 MeV molecular deuterium ions, was stably confined by a simple magnetic mirror field, in a device named Migma. The plasma ion number was determined by using both silicon surface barrier detectors and an RF pickup system. For the former, a Monte Carlo type simulation of the system was employed to analyze the experimental data. The two methods were found to agree at a value for the trapped ion number within the experimental error. The RF system also measured the impact parameter distribution of the trapped ions. An analytic simulation of beam-gas dissociation was found to fit the experimental data at poor vacuums (the Migma II experiments); at good vacuums (Migma III), the expermental data indicated a higher trapping rate than possible due to beam-gas collisions, and an impact parameter more highly peaked at cell center than expected. This indicates that other dissociation mechanisms were in effect, such as Lorentz and beam-plasma.

PLASMA WAVE PHENOMENA

19836 Stimulated brillouin sidescatter and backscatter of carbon dioxide laser radiation from a laser-altered arc plasma. Herbst, M.J. Los Angeles, CA; University of California (1979). 102p. University Microfilms Order No. 79-13,729.

Thesis (Ph. D.).

Linear theory predicts a weak dependence on angle of Stimulated Brillouin Scattering growth in underdense plasmas. With experimental conditions such that the theory for the convective Brillouin instability in a finite-length plasma is applicable, an investigation of sidescattering and backscattering of radiation from an underdense plasma is conducted. Using a 30 Joule, 50 nanosecond FWHM CO_2 laser pulse, hydrogen plasmas with densities as high as 10^{18} cm^{-3} are formed by the laser in gas preionized by a pulsed, high-current arc. Brillouin sidescatter and backscatter are identified, and a dependence of the properties of the scattered light upon the level of arc preionization is observed. Evidence is found for laser-induced plasma motion and for self-focussing of the beam by the plasma. Observed scattering levels are compared with theoretical prediction, as are relative levels of sidescatter and backscatter; in determining the latter, an observed lack of dependence of sidescatter level on incident laser polarization must be taken into account. Finally, in an attempt to establish whether previously observed spikiness in Brillouin backscatter is due to mode-beating in the pump, Brillouin scattering of a smoothed CO_2 input is studied.

19837 Harmonic generation and parametric excitation in a beam-plasma system. Kerst, R.A. Urbana, IL; University of Illinois (1978). 167p. University Microfilms Order No. 79-13,509.

Thesis (Ph. D.).

Harmonic generation by wave-wave and wave-particle interactions and parametric excitation of plasma and ion-acoustic waves by a beam-plasma instability are studied, theoretically and experimentally, in a cold beam-plasma system. The dispersion relations for plasma and ion-acoustic waves are calculated. Coupling constants for harmonic generation and parametric excitation are calculated and the equations for the wave amplitudes are solved numerically for some important cases. Measurements are made of fundamanental and harmonic wave intensities. Two distinct harmonic generation mechanisms are identified and attributed to wave-wave and wave-particle interactions. Measurements are made of sideband excitation by a beam-plasma instability. Connection of the sideband production with ion dynamics is established. The sideband excitation mechanism is identified as a parametric instability, and good agreement with theory is found.

FUSION POWER PLANT TECHNOLOGY

19838 (ANL/FPP/TM—127) **Recent contributions to fusion reactor design and technology development.** (Argonne National Lab., IL (USA)). Nov 1979. Contract W-31-109-ENG-38. 91p. Dep. NTIS, PC A05/MF A01.

The report contains a collection of 16 recent fusion technology papers on the STARFIRE Project, the study of alternate fusion fuel cycles, a maintainability study, magnet safety, neutral beam power supplies and pulsed superconducting magnets and energy transfer. This collection of papers contains contributions for Argonne National Laboratory, McDonnell Douglas Astronautics Company, General Atomic Company, The Ralph M. Parsons Company, the University of Illinois, and the University of Wisconsin. Separate abstracts are presented for each paper. (MOW)

19839 (ANL/FPP/TM—127, pp 1-6) **STARFIRE: a commercial tokamak reactor.** Baker, C.C. (Argonne National Lab., IL); Abdou, M.A.; DeFreece, D.A.; Trachsel, C.A.; Graumann, D.; Kokoszenski, J. Nov 1979.

In Recent contributions to fusion reactor design and technology development.

The STARFIRE Project was initiated in May 1979, with the goal of completing the design study by October 1980. The purpose of this paper is to present an overview of the major parameters and design features that have been tentatively selected for STARFIRE.

19840 (ANL/FPP/TM—127, pp 7-11) **Results of systems studies for the STARFIRE commercial tokamak.** Abdou, M.A. (Argonne National Lab., IL); Ehst, D.A.; Waganer, L.M. Nov 1979.

In Recent contributions to fusion reactor design and technology development.

Extensive system and tradeoff studies were performed to support the selection process for the major parameters and design features of the STARFIRE commercial reactor. With a thermal power of 3800 MW, a neutron wall load of 3.5 MW/m^2 results in a relatively small-size reactor without imposing excessive requirements on the first-wall cooling capability, maximum toroidal-magnetic field, and frequency of structural material requirements. This moderately high-wall load requires that the first-wall coolant be liquid (water or lithium) and the lifetime of the structural material is >15 MW-yr/m^2. With moderate plasma elongation and beta the required maximum toroidal-field is $\sim$ 11 T. STARFIRE is operated steady-state with no OH coil.

19841 (DOE/ET/52049—13) **INTOR: a first-generation tokamak experimental reactor.** Stacey, W.M. Jr.; Gilleland, J.R.; Kulcinski, G.L.; Rutherford, P.H. (Georgia Inst. of Tech., Atlanta (USA); General Atomic Co., San Diego, CA (USA); Wisconsin Univ., Madison (USA); Princeton Univ., NJ (USA). Plasma Physics Lab.). Feb 1980. Contract AS05-79ET52049. 52p. Dep. NTIS, PC A04/MF A01.

An intensive, year-long, international evaluation of the next major tokamak beyond the generation of large experiments currently under construction was carried out during 1979. This evaluation consisted of the definition of objectives, an assessment of the physics and technology base and R and D needs and the identification of a set of parameters that physically characterize the machine.

19842 (ORNL/TM—7227) **Tokamak plasma variations under rapid compression.** Holmes, J.A.; Peng, Y.K.M.; Lynch, S.J. (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract W-7405-ENG-26. 26p. Dep. NTIS, PC A03/MF A01.

Changes in plasmas undergoing large, rapid compressions are examined numerically over the following range of aspect ratios A:3 ≧ A ≧ 1.5 for major radius compressions of circular, elliptical, and D-shaped cross sections; and 3 ≦ A ≦ 6 for minor radius compressions of circular and D-shaped cross sections. The numerical approach combines the computation of fixed boundary MHD equilibria with single-fluid, flux-surface-averaged energy balance, particle balance, and magnetic flux diffusion equations. It is found that the dependences of plasma current I/sub p/ and poloidal beta anti β/sub p/ on the compression ratio C differ significantly in major radius compressions from those proposed by Furth and Yoshikawa. The present interpretation is that compression to small A dramatically increases the plasma current, which lowers anti β/sub p/ and makes the plasma more paramagnetic. Despite large values of toroidal beta anti β/sub T/ (≧ 30% with q/sub axis/ ≃ 1, q/sub edge/ ≃ 3), this tends to concentrate more toroidal flux near the magnetic axis, which means that a reduced minor radius is required to preserve the continuity of the toroidal flux function F at the plasma edge. Minor radius compressions to large aspect ratio agree well with the Furth-Yoshikawa scaling laws.

19843 (PNL—2987) **Fusion reactor design studies: standard unit costs and cost scaling rules.** Schulte, S.C.; Bickford, W.E.; Willingham, C.E.; Ghose, S.K.; Walker, M.G. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1979. Contract EY-76-C-06-1830. 89p. Dep. NTIS, PC A05/MF A01.

This report establishes standard unit costs and scaling rules for estimating costs of material, equipment, land, and labor components used in magnetic confinement fusion reactor plant construction and operation. Use of the standard unit costs and scaling rules will add uniformity to cost estimates, and thus allow valid comparison of the economic characteristics of various reactor concepts.

19844 (PPPL—1640) **OCLATOR II (One Coil Low Aspect Toroidal Reactor).** Yoshikawa, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1980. Contract EY-76-C-02-3073. 66p. Dep. NTIS, PC A04/MF A01.

Following the general description of OCLATOR (I), more thoughts are presented here. It suggests that the blanket may not be changed for the plant lifetime. Also miniaturization of OCLATOR is discussed, especially if the ripple turbulence could be improved upon the presently set limit which applies to a large number of ripples.

19845 (UCRL—83962) **Magnetic mirror fusion: status and prospects.** Post, R.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 11 Feb 1980. Contract W-7405-ENG-48. 25p. (CONF-800325—4). Dep. NTIS, PC A02/MF A01.

From ASME symposium on fusion energy products; Albuquerque, NM, USA (20 Mar 1980).

Two improved mirror systems, the tandem mirror (TM) and the field-reversed mirror (FRM) are being intensively studied. The twin practical aims of these studies: to improve the economic prospects for mirror fusion power plants and to reduce the size and/or complexity of such plants relative to earlier approaches to magnetic fusion. While at the present time the program emphasis is still strongly oriented toward answering scientific questions, the emphasis is shifting as the data accumulates and as larger facilities - ones with a heavy technological and engineering orientation - are being prepared. The experimental and theoretical progress that led to the new look in mirror fusion research is briefly reviewed, the new TM and the FRM ideas are outlined, and the projected future course of mirror fusion research is discussed.

19846 **Density and magnetic field measurements in the Tormac IV-c plasma.** Coonrod, J.W. Jr. Berkeley, CA; University of California (1978). 183p. University Microfilms Order No. 79-14,573.

Thesis (Ph. D.).

Tormac is a concept for magnetically confining a high-β fusion plasma in a toroidal, stuffed line cusp. A Tormac plasma has two regions: an interior confined on the closed toroidal field lines of the stuffing field, and an exterior sheath on open, cusped field lines. The interior plasma gives the device a longer confinement time than a standard mirror, while the favorable curvature of the cusp fields allow the plasma to be stable at higher values of β (the ratio of the plasma pressure to magnetic pressure) than a totally closed configuration like Tokamak. This thesis describes the design, construction and operation of Tormac IV-c, and reports on the results, with emphasis on describing the behavior of the density compression and field penetration.

BLANKET ENGINEERING

19847 (ANL/FPP/TM—127, pp 16-21) **Assessment of solid breeding blanker options for commercial tokamak reactors.** Smith, D.L. (Argonne National Lab., IL); Clemmer, R.G.; Davis, J.W. Nov 1979.

In Recent contributions to fusion reactor design and technology development.

This study examines the materials and design implications regarding the use of solid breeding materials with respect to compatibility with structure and coolant, tritium processing, chemical and radiation stability, and thermal-hydraulics. Four solid breeding materials considered, viz., Li_7Pb_2, Li_2O, Li_2SiO_3, and $LiAlO_2$, are representative of the metallic and ceramic compounds available. The major design problems regarding the use of solid breeding materials relate to the limited range of operating temperatures acceptable for tritium release and chemical stability or compatibility. The allowable ranges of breeder temperatures for which in-situ tritium recovery is potentially viable are evaluated for the candidate breeding materials.

19848 (ANL/FPP/TM—127, pp 22-26) **First wall and blanket design for the STARFIRE commercial tokamak power reactor.** Morgan, G.D. (McDonnell Douglas Astronautics Co., St. Louis, MO); Trachsel, C.A.; Cramer, B.A.; Bowers, D.A.; Smith, D.L. Nov 1979.

In Recent contributions to fusion reactor design and technology development.

The first wall and blanket design concepts being evaluated for the STARFIRE commercial tokamak reactor study are presented. The two concepts represent different approaches to the mechanical design of a tritium breeding blanket using the reference materials options. Each concept has a separate ferritic steel first wall cooled by heavy water (D_2O), and a ferritic steel blanket with solid lithium oxide breeder cooled by helium. A separate helium purge system is used in both concepts to extract tritium. The two concepts are compared and relative advantages and disadvantages for each are discussed.

19849 **Neutronic performance of fusion reactor blankets with different coolants and structural arrangements.** Chao, J.; Mikic, B.B.; Todreas, N.E. (Massachusetts Inst. of Tech., Cambridge). *Nucl. Technol.;* **45**: No. 2, 113-120(Sep 1979).

The effects of heating and tritium breeding of using different coolants and structural arrangements have been investigated for tokamak fusion reactors. Coolants considered are lithium, helium, and flibe (a molten salt, LiF-BeF_2 eutectic). Structural arrangements are modeled by using four 20-cm breeding zones between a 0.5-cm-thick first wall and a 10-cm graphite reflector. Different values for the volume percent of Type 316 stainless steel are assigned in four breeding zones to represent a nonuniformly distributed structural material that satisfies various thermal-hydraulic requirements.

MAGNET COILS AND FIELDS

19850 (ANL/FPP/TM—127, pp 32-35) **Superconducting poloidal coils for STARFIRE commercial reactor.** Wang, S.T. (Argonne National Lab., IL); Evans, K. Jr.; Turner, L.R.; Huang, Y.C.; Prater, R.; Alcorn, J. Nov 1979.

In Recent contributions to fusion reactor design and technology development.

STARFIRE is considered to be the tenth commercial tokamak power plant. A preliminary design study on its superconducting poloidal coil system is presented. Key features of the design studies are: the elimination of the ohmic heating coil; the trade-off studies of the equilibrium field coil locations; and the development of a conceptual design for the superconducting equilibrium field coils. Described are the 100 kA cryostable conductor design, the coil structure, and evaluation of the coil forces.

19851 (ANL/FPP/TM—127, pp 36-40) **Toroidal field coil system for STARFIRE, a preliminary assessment.** Alcorn, J.S. (General Atomic Co., San Diego, CA); Wang, S.T.; Turner, L.R. Nov 1979.

In Recent contributions to fusion reactor design and technology development.

An important element of STARFIRE is the 12-coil superconducting toroidal field coil system which is required to generate 5.6 tesla at the 7.0 m plasma axis, with a peak-to-peak field ripple of 1% (maximum). Internal spatial requirements dictate a clear bore about 15 1/2 m high x 10 m wide, resulting in a total stored energy of 67 GJ.

19852 (ANL/FPP/TM—127, pp 60-64) **Safety of superconducting fusion magnets: twelve problem areas.** Turner, L.R. Nov 1979.

In Recent contributions to fusion reactor design and technology development.

Twelve problem areas of superconducting magnets for fusion reaction are described. These are: quench detection and energy dump, stationary normal region of conductor, current leads, electrical arcing, electrical shorts, conductor joints, forces from unequal currents, eddy current effects, cryostat rupture, vacuum failure, fringing field and instrumentation for safety. Priorities among these areas are suggested.

19853 (ANL/FPP/TM—127, pp 78-79) **Development of a 50 kA cryostable ac superconducting cable.** Kim, S.H.; Wang, S.T. Nov 1979.

In Recent contributions to fusion reactor design and technology development.

A design of a 50 kA cable at 8 T for superconducting ohmic heating coils is presented. The cable, which will be cryostable with relatively low ac losses, is composed of 24 basic cables and stainless steel backbone. A non-metallic cryostat for the test of pancake coils of the cable is developed.

19854 (DOE/ET/52005—1) **12 tesla test coil. Annual progress report.** (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). 1979. Contract EG-77-S-02-4182. 7p. Dep. NTIS, PC A02/MF A01.

The Plasma Fusion Center at MIT has been charged with responsibility for the design, development, fabrication and test operation of a Niobium-3-Tin Superconducting Test Coil. Research is described on DOE's 12 tesla coil demonstration program in which several one-meter diameter superconducting test coils will be inserted and tested in DOE's High Field Test Facility at the Lawrence Livermore Laboratories. The work was initiated at the start of FY 79. FY 79 saw the completion of our Preliminary Design and the initiation of three (3) subcontracts: (1) Westinghouse review of the Preliminary Design, (II) Supercon, Inc. development of a tubular copper matrix, Nb_3Sn Superconductor and (III) Airco optimization of the LCP-W Nb_3Sn superconductor for 12T service. In addition, Airco was charged with the production of a 1000 foot length of model 15,000A conductor. Coil winding exercises were initiated at the Everson Electric Company.

POWER SUPPLIES, ENERGY STORAGE

19855 (ANL/FPP/TM—127, pp 65-71) **Overcurrent protection for the TFTR neutral beam sources during spark down.** Praeg, W.F. Nov 1979.

In Recent contributions to fusion reactor design and technology development.

The accelerating grid of a neutral beam source (NBS) of the Tokamak Fusion Test Reactor (TFTR) operates at 120 kV and 65 A. The capacitance to ground between the switch tube (ST) and the NBS is $C_1 \sim 5$ nF ($\sim$ 36 J). The arc and filament power supplies for the NBS float at 120 kV and have a capacitance to ground of $C_2 \sim 2$ nF ($\sim$ 14 J). When the NBS sparks to ground, C_2 begins to discharge immediately. The ST impedance limits the fault current from the high voltage (HV) power supply to $\sim$ 100 A until it disconnects the power source <2 μs after spark down. In case the ST fails, a crowbar removes the power source $\sim$ 4 μs after spark down and C_1 begins to discharge. During spark down, fault currents are limited with a saturated time-delay transformer (STDT) connected between the ST and the NBS and with a snubber, which is in the arc and filament power leads, in connection with a spark gap. Alternatively, STDT's can be used for the HV and for the arc and filament power leads. This paper presents design details and experimental results of the overcurrent protection circuits.

19856 (ANL/FPP/TM—127, pp 80-83) **General phase-frequency shifting in the three-phase inductor-converter bridge.** Ehsani, M.; Kustom, R.L.; Fuja, R.E.; Barnard, T.J. Nov 1979.

In Recent contributions to fusion reactor design and technology development.

A fundamental method of shifting phase frequency in the inductor-converter bridge (ICB) for the purpose of controlling the power in real time is presented. Transient switching sequences needed to implement phase-frequency shifting can be developed by the use of this method and the other five system constraints. Two of the constraints that have been expressed in equation form so far are presented. Finally, an alternative algorithm for computing the frequency shifting transient sequences in real time is suggested.

19857 (UCRL—82873) **TMX magnet control system.** Goerz, D.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Nov 1978. Contract W-7405-ENG-48. 5p. (CONF-791102—124). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

A control system utilizing a microcomputer has been developed that controls the power supplies driving the Tandem Mirror Experiment (TMX) magnet set and monitors magnet coil operation. The magnet set consists of 18 magnet coils that are driven by 26 dc power supplies. There are two possible modes of operation with this system: a pulse mode where the coils are pulsed on for several seconds with a dc power consumption of 16 MW; and a continuous mode where the coils can run steady state at 10 percent of maximum current ratings. The processor has been given an active control role and serves as an interface between the operator and electronic circuitry that controls the magnet power supplies. This microcomputer also collects and processes data from many analog singal monitors in the coil circuits and numerous status signals from the supplies. Placing the microcomputer in an active control role has yielded a compact, cost effective system that simplifies the magnet system operation and has proven to be very reliable. This paper will describe the TMX magnet control sytem and discuss its development.

19858 (UCRL—82951) **Test and evaluation of the BBC CQK 200-4 modulator tube for the MFTF sustaining neutral beam power supply system.** Eckard, R.D.; Van Ness, H.W.; Hesselgrave, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.; Aydin Energy Div., Palo Alto, CA (USA)). 12 Nov 1979. Contract W-7405-ENG-48. 8p. (CONF-791102—145). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The BBC CQK 200-4 Tube was tested by Aydin at LLL, to confirm that it would switch 90 kV after conducting 88 amperes for 30 seconds. The CQK 200-4 is a recent modification of the CQK 200-3, an Rf transmitter tube designed for continuous loading, to increase the anode hold-off voltage to 150 kV. During the design life of the tube it will be subjected to 10^5 to 10^6 cyclic thermal loads. Two concerns are that (1) during the 30 second high current load, the screen grid may have excessive dissipation causing a loss of control of the tube, and (2) the cyclic temperature-induced stresses in the anode may cause fatigue failures that will reduce the tube's useful life. The first concern was addressed by performing full scale tests at the LLL test facility.

HEATING AND FUELING SYSTEMS

19859 (ANL/FPP/TM—127, pp 46-53) **Fusion reactor technology impact of alternate fusion fuels.** Baker, C.C. (Argonne National Lab., IL); Bolon, A.; Clemmer, R. Nov 1979.

In Recent contributions to fusion reactor design and technology development.

The initial results of a study carried out to assess some of the technology implications of non-D-T fusion fuel cycles are presented. The primary emphasis in this paper is on D-D, catalyzed-D and D-^{3}He fuel cycles. Tokamaks and field-reversed mirrors have been selected as sample confinement concepts. The technology areas considered include first wall design considerations, shielding requirements, fuel cycle requirements and some safety and environmental considerations. Conclusions resulting from the study are also presented.

TRITIUM PROCESSING, ENVIRONMENT AND SAFETY

19860 (ANL/FPP/TM—127, pp 27-31) **Tritium handling and vacuum considerations for the STARFIRE commercial tokamak reactor.** Finn, P.A. (Argonne National Lab., IL); Clemmer, R.G.; Maroni, V.A.; Dillow, C. Nov 1979.

In Recent contributions to fusion reactor design and technology development.

Tritium processing and vacuum pumping requirements were analyzed for the STARFIRE commercial fusion reactor design. It was found that vacuum pumps having a helium capture probability of 0.5 (total helium pump speed 1.2×10^4 m^3/s) in combination with the proposed STARFIRE limiter-vacuum concept is sufficient to achieve plasma impurity control and, simultaneously, high fractional burnup (11%). The high fractional burnup and minimum fuel recycle time result in a very low fuel cycle tritium inventory, $\sim$ 1300 g. A Lean-T burn method that can further reduce the fuel cycle inventory by 30 to 50% is discussed. D_2O is proposed as a first wall coolant from considerations of plasma contamination (due to hydrogen isotope permeation through coolant tubes) and enrichment of recycled tritium from the coolant circuit. Tritium recovery from solid breeders, under realistic structural and breeder materials constraints, appears to represent a formidable task. The tritium inventory in the solid breeder is estimated to be as high as 10 kg, which would make the blanket the largest single hold-up point for tritium in the plant.

19861 (DOE/ID/01570—T3) **Environmental and safety aspects of fusion.** Crocker, J.G. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 8p. (CONF-800325—3). Dep. NTIS, PC A02/MF A01.

From ASME symposium on fusion energy products; Albuquerque, NM, USA (20 Mar 1980).

In any deuterium-tritium burning fusion reactor there are several safety and environmental issues that must be addressed. The major issues involve: (1) use of tritium in the fuel cycle, (2) activation of structural materials, corrosion products in fluid streams, and reactor hall environment by high-energy neutrons, (3) the requirement for use of lithium to breed tritium and the attendant fire potential, and (4) the handling and disposal of radioactive waste. Also, a major concern with the magnetic systems is the presence of large superconducting magnets and magnetic fields and their potential effects on personnel, structures, and equipment. Each of these issues is discussed.

INERTIAL CONFINEMENT TECHNOLOGY

19862 (SAND—79-2454) **Fuel energy balance studies of pellet ignition requirements.** Widner, M.M. (Sandia Labs., Albuquerque, NM (USA)). Dec 1979. Contract EY-76-C-04-0789. 20p. Dep. NTIS, PC A02/MF A01.

A simple power balance model is used to study DT fuel ignition requirements in the parameter regime appropriate for many ICF target applications. The model includes fuel energy loss due to thermal conduction and radiation, gain due to PdV work and α particle deposition, and pusher boundary conditions. It can be shown analytically that a minimum pusher velocity of $\sim 10^7$ cm/sec is necessary to achieve ignition, with corresponding fuel rho R $\simeq$ .1 gm/cm^2 and T $\simeq$ 4 keV. If thermal conduction losses are reduced, then the minimum necessary velocity required for ignition is shown to be substantially reduced. Various formulas and scaling laws are presented which should aid target design calculations which use large hydrocode models.

19863 (UCID—18573) **Influence of radiation transport on lithium fall motion in an ICF reactor.** Glenn, L.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Mar 1980. Contract W-7405-ENG-48. 48p. Dep. NTIS, PC A03/MF A01.

The fluid motion in the cavity of a HYLIFE reactor was calculated for the two extreme cases of optically thin and thick lithium gas in the hot core. The distinction is important because in the optically thin case (emission approximation) a major fraction of the gas energy is re-radiated to the main fall, following the lithium implosion, whereas in the optically thick case (diffusion approximation) virtually none escapes. This, in turn, has a major influence on the impulse ultimately imparted to the reactor walls. The complete set of finite difference equations used is given in an appendix.

19864 (UCRL—15200) **High energy bremsstrahlung in an intense laser field.** Schlessinger, L.; Wright, J.A. (R and D Associates, Marina del Rey, CA (USA)). Feb 1980. Contract W-7405-ENG-48. 24p. Dep. NTIS, PC A02/MF A01.

The cross section for bremsstrahlung emission and absorption by electrons in an intense laser field has been calculated in the Born approximation for the electron-ion potential. Typical numerical results are presented as a function of the ratio of the electron guiver energy to its energy and the ratio of the bremsstrahlung energy to the electron energy. The intense field correction factor for the rate of bremsstrahlung emission and absorption for electrons with a Boltzmann distribution of energies has been calculated. Numerical results for the correction factor are presented for the Boltzmann case as a function of the ratio of the electron quiver energy to its thermal energy and the ratio of the bremsstrahlung energy to the thermal energy. For typical laser fusion parameters, this correction factor which is the ratio of the thermal bremsstrahlung emission rate in the intense laser field to the rate at zero field can be quite significant. For a laser of wavelength 1.06 μm at an intensity of 3 x 10^{15} w/cm^2 and an electron temperature of 1 keV, the correction factor varies from 0.98 at a bremsstrahlung energy of 100 V to greater than 5 at a bremsstrahlung energy of 10 keV.

19865 (UCRL—82550(Rev.1)) **Solid state track detectors in the inertial confinement fusion program at LLL.** Ceglio, N.M.; Benton, E.V. (California Univ., Livermore (USA). Lawrence Livermore Lab.; San Francisco Univ., CA (USA)). 30 Jan 1980. Contract W-7405-ENG-48. 27p. (CONF-790765—4). Dep. NTIS, PC A03/MF A01.

From 10. international conference on solid state nuclear track detectors; Lyons, France (2 Jul 1979).

Two recent conference papers on the use of cellulose nitrate and CR-39 to diagnose laser fusion targets are combined with a chronological introduction and update to efforts in this area.

19866 (UCRL—83541) **Compression measurement in laser driven implosion experiments.** Attwood, D.T.; Ceglio, N.M.; Campbell, E.M.; Larsen, J.T.; Matthews, D.M.; Lane, S.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1979. Contract W-7405-ENG-48. 39p. (CONF-791109—2). Dep. NTIS, PC A03/MF A01.

From 5. workshop on laser interaction; Rochester, NY, USA (5 Nov 1979).

The measurement of compression is described in the context of the Inertial Confinement Fusion Program's transition from thin walled exploding pusher targets, to thicker walled targets which are designed to lead the way towards ablative type implosions which will result in higher fuel density and rho R at burn time. Several general aspects relating to the current state of affairs in compression experiments are discussed.

19867 **Lattice calculations and three-dimensional effects in a laser fusion-fission reactor.** Ragheb, M.M.H.; Abdel-Khalik, S.I.; Youssef, M.; Maynard, C.W. (Univ. of Wisconsin, Madison). *Nucl. Technol.;* **45**: No. 2, 140-152(Sep 1979).

Three-dimensional neutronics models of the SOLASE-H fusion-fission reactor have been analyzed by Monte Carlo. In this design, light water reactor (LWR) fertile ThO_2 fuel bundles are enriched in the fissile isotope ^{233}U and then shipped for burning in the LWRs. A concept where the fertile fuel bundles constitute a lattice configuration with the moderator-multiplier material is investigated. Parametric lattice calculations as a function of the neutron moderator-multiplier to fuel volume ratio (v/sub m//v/sub f/) in the lattice show that it is possible in such a concept to enhance the fissile nuclei production density in the fertile fuel, compared to cases where a lattice configuration is not used.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

REFER ALSO TO CITATION(S) 19860

19868 (ANL/FPP/TM—127, pp 12-15) **Impurity control system for the STARFIRE commercial fusion reactor.** Brooks, J.N. (Argonne National Lab., IL); Baker, C.C.; Stevens, H.C.; Trachsel, C.A. Nov 1979.

In Recent contributions to fusion reactor design and technology development.

The STARFIRE impurity control system is based on a low-Z coated limiter/vacuum system which collects and pumps about 30% of the particle flux at the edge of the plasma. This pumping efficiency, when combined with about a 1.5-T additional margin in the toroidal magnetic field, is sufficient to maintain the steady-state helium concentration to $\sim$ 10% while permitting a tritium burnup fraction at $\sim$ 10%. In order to keep the heat load on the limiter to reasonable limits, about 80% of the alpha-particle energy is radiated to the first wall by injecting a very small amount of appropriate impurity ions.

19869 (ANL/FPP/TM—127, pp 41-45) **Maintenance considerations of the STARFIRE commercial tokamak.** Trachsel, C.A. (McDonnell Douglas Astronautics Co., St. Louis, MO); Zahn, H.S.; Field, R.E.; Stevens, H.C. Nov 1979.

In Recent contributions to fusion reactor design and technology development.

This paper presents the maintenance approach, the commercial tokamak design features that enhance maintenance and preliminary repair time and required mean-time-between-failures for major subsystems. Reactor hall building and maintenance equipment requirements including hot cells, coil rewinding, and cranes are discussed.

19870 (ANL/FPP/TM—127, pp 54-59) **Shielding and maintainability in an experimental tokamak.** Abdou, M.A. (Argonne National Lab., IL); Fuller, G.; Hager, E.R.; Vogelsang, W.F. Nov 1979.

In Recent contributions to fusion reactor design and technology development.

This paper presents the results of an attempt to develop an understanding of the various factors involved. This work was performed as a part of the task assigned to one of the expert groups on the International Tokamak Reactor (INTOR). The shielding penalties for requiring personnel access are quantified. This is followed by a quantitative estimate of the benefits associated with personnel access. The penalties to the benefits and conclusions and recommendations on resolving the issue are discussed.

19871 (ANL/FPP/TM—127, pp 72-77) **Resistivity, hysteresis, and magnetization of 9% Cr stainless steel as a function of temperature and its electromagnetic shielding effects in cylindrical structures.** Praeg, W.F. Nov 1979.

In Recent contributions to fusion reactor design and technology development.

Ferromagnetic stainless steels may offer significantly greater wall life-times for first wall/blanket and vacuum vessel structures than commonly used non-magnetic stainless steels. One steel under consideration has the following composition, in wt %, Fe(86.24), Cr(9), Mo(2), Mn(1), Si(0.75), Nb(0.50), V(0.30), C(0.15), P(0.3), S(0.30). There appears to be no literature on the electromagnetic properties of this material. Therefore, the resistivity, the hysteresis loops, and magnetization were measured as a function of temperature up to the Curie point.

19872 (COO—4184-8) **Developing maintainability for fusion power systems. Final report.** Zahn, H.S.; Mantz, H.C.; Curtis, C.T.; Buchheit, R.J.; Green, W.M.; Zuckerman, D.S. (McDonnell Douglas Astronautics Co., St. Louis, MO (USA)). Nov 1979. Contract EG-77-C-02-4184. 225p. Dep. NTIS, PC A10/MF A01.

The overall purpose of the study is to identify design features of fusion power reactors which contribute to the achievement of high levels of maintainability. Previous phases evaluated several commercial tokamak reactor design concepts. This final phase compares the maintainability of a tandem mirror reactor (TMR) commercial conceptual design with the most maintainable tokamak concept selected from earlier work. A series of maintainability design guidelines and desirable TMR design features are defined. The

effects of scheduled and unscheduled maintenance for most of the reactor subsystems are defined. The comparison of the TMR and tokamak reactor maintenance costs and availabilities show that both reactors have similar costs for scheduled maintenance at 19.4 and 20.8 million dollars annually and similar scheduled downtime availability impacts, achieving approximate availabilities of 79% at optimized maintenance intervals and cost of electricity.

19873 (MITNRL—003) **Alloy development for irradiation performance in fusion reactors. Annual report, September 1978-September 1979.** (Massachusetts Inst. of Tech., Cambridge (USA). Nuclear Reactor Lab.). Dec 1979. Contract ER-78-S-02-5098. 112p. Dep. NTIS, PC A06/MF A01.

This report is the first annual report of research activities directed toward the development of improved performance alloys for such severe environments as the fusion reactor first wall. Major project efforts are directed toward definition of alloy performance requirements, alloy design, alloy production and alloy performance evaluation. Rapid solidification from the melt is being used to manipulate alloy microstructure and to produce the desired design properties. Integrated testing and modeling procedures have been developed to minimize testing requirements. Major project activities are divided into tasks, which are carried out with the coordinated support of staff and facilities in four M.I.T. Departments and Laboratories. Progress during the first project year and future plans are summarized in this annual report.

19874 (PPPL—1646) **Glow discharge conditioning of the PDX vacuum vessel.** Dylla, H.F.; Cohen, S.A.; Rossnagel, S.M.; McCracken, G.M.; Staib, P. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1980. Contract EY-76-C-02-3073. 26p. Dep. NTIS, PC A03/MF A01.

A glow discharge technique has been developed and applied to the conditioning of the large (38 m^3) Poloidal Divertor Experiment (PDX) vacuum vessel. The discharge parameters and working gas (H_2) were chosen to maximize C and O removal and minimize metal sputtering. The glow discharge was produced by biasing one or two internal anodes at 400 V to sustain a discharge current of 2 to 4 A per anode. Purified H_2 at a pressure of 3 x 10^{-3} torr was flowed through PDX at ~ 10 t-l/s. The effectiveness of the glow discharge conditioning was monitored by measuring impurity gas (CH_4, C_2H_4, and CO) exhaust rates by mass spectrometry and C and O surface removal rates by in-situ AES and XPS.

19875 (UCRL—15146) **Mirror Fusion Test Facility data compression study. Final report.** (Hughes Aircraft Co., Newport Beach, CA (USA). Microelectronics Products Div.). Nov 1979. Contract W-7405-ENG-48. 143p. Dep. NTIS, PC A07/MF A01.

This report is organized as follows. Discussions are given of three of the most important data compression methods that have been developed and studied over the years: coding, transforms, and redundancy reduction. (A brief discussion of how to combine and synthesize these ideas, and others, into a system is given). Specific ideas for compressing MFTF diagnostics and control data are developed. Listings and instructions for using FORTRAN programs that were compiled on the Livermore MFTF computers during the course of the study are also given.

GENERAL AND MISCELLANEOUS

MANAGEMENT

REFER ALSO TO CITATION(S) 18924

19876 (DOE/S—0010(80)) **Secretary's annual report to Congress.** (Department of Energy, Washington, DC (USA)). Jan 1980. 184p. Dep. NTIS, PC A09/MF A01.

This second annual report of the DOE covers activities of all elements of the department except the independent FERC, which issues its own annual report. Individual chapters concern a posture statement, conservation, solar and other renewable energy, fossil energy, electric energy, nuclear energy, the environment, defense programs, international programs, general science programs, energy information, economic regulation, energy production, and support operations. The following appendixes are also included: foreign direct investments in US energy sources and supplies, exports of energy resources by foreign companies, major recipients of DOE funding, actions taken regarding disclosure of energy assets by DOE employees, financial assistance programs for alternative fuel demonstration facilities, and 1978 budget summary. 16 figures, 56 tables. (RWR)

19877 (DP—929-1(Suppl.3)) **Publications, 1977-1979.** Hilborn, H.S. (comp.). (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Mar 1980. Contract EY-76-C-09-0001. 196p. Dep. NTIS, PC A09/MF A01.

This is a compilation of documents that communicate the results of scientific and technical work done at Savannah River. The compilation includes those documents that have been published (research and development reports, journal articles, book chapters, etc.), and documents that have been announced in Energy Research Abstracts. Where applicable, the meeting at which the paper was presented is given. This report updates the information included in DP-929, Rev. 2, Publications, 1951 through 1971 and DP-929-1, Publications, 1972 through 1976, and replaces DP-929-1, Supplements 1 and 2. The bibliographic listing is arranged alphabetically by the first-mentioned author of each document. The listing includes an identifying code number. This identifying code is used to cross reference the author and subject listings with the bibliographic information. The subject listing is arranged alphabetically by key word out of context (KWOC) indexing of the titles. The listing includes the identifying code number and the complete title. The author listing includes in alphabetical order all authors, coauthors, editors, and compilers with identifying code numbers, and the titles of all documents on which their names appear. (RWR)

19878 (EPA—600/9-79-017) **Who's Who V: the Interagency Energy/Environment R and D Program directory and index.** Jacoff, F.S. (ed.). (Environmental Protection Agency, Washington, DC (USA)). Jan 1980. 79p. NTIS.

The Interagency Energy/Environment Research and Development Program was created to provide a means of communication among the Federal research community, policy-level decision-makers, and the interested public. Traditionally, Interagency Program research results have been communicated via project-specific reports, seminars, and conferences. The Who's Who document consolidates, in directory format, representative research being performed by participating agencies, as well as by individuals and organizations outside the program who are involved in related work. The Health and Environmental Effects Program deals with measurement systems and instrumentation, transport and fate, health effects, and ecological effects. The Control Technology Program deals with fuel extraction; fuel processing, preparation, and advanced combustion; environmental impacts of conventional and advanced energy systems; flue gas sulfur oxide control; nitrogen oxide control; and flue gas particulate control. (RWR)

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 19812

19879 (DOE/ER/05046—15) **Role of slack variables in quasi-Newton methods for constrained optimization.** Tapia, R.A. (Rice Univ., Houston, TX (USA). Dept. of Mathematical Sciences). 1979. Contract EY-76-S-05-5046. 12p. Dep. NTIS, PC A02/MF A01.

In constrained optimization the technique of converting an inequality constraint into an equality constraint by the addition of a squared slack variable is well known but rarely used. In choosing an active constraint philosophy over the slack variable approach, researchers quickly justify their choice with the standard criticisms: the slack variable approach increases the dimension of the problem, is numerically unstable, and gives rise to singular systems. It is shown that these criticisms of the slack variable approach need not apply and the two seemingly distinct approaches are actually very closely related. In fact, the squared slack variable formulation can be used to develop a superior and more comprehensive active constraint philosophy.

19880 (DOE/ER/05046—17) **QDN: a variable storage algorithm for unconstrained optimization.** Garg, N.K.; Tapia, R.A. (Rice Univ., Houston, TX (USA). Dept. of Mathematical Sciences). 1978. Contract EY-76-S-05-5046. 28p. Dep. NTIS, PC A03/MF A01.

The algorithm quasi-discrete Newton (QDN) is presented which essentially uses the preconditioned conjugate gradient method to solve iteratively the linear systems which arise in Newton's method. Directions of negative curvature are obtained and dealt with in an efficient and natural manner. A main feature of QDN is that the amount of storage required is controlled by the choice of the preconditioning matrix. Preliminary numerical experimentation indicates that QDN compares favorably with the now standard secant methods and the standard conjugate gradient methods. 1 table.

19881 (EGG-IS—5118) **Use of MINITAB II at the Idaho National Engineering Laboratory.** Rasmuson, D.M.; Nelson, A.J. Jr. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1980. Contract EY-76-C-07-1570. 10p. Dep. NTIS, PC A02/MF A01.

An overview of the capabilities of MINITAB II, a statistical computing system designed to handle small and medium-sized data sets, is presented. Details necessary to access and use the system at the Idaho National Engineering Laboratory (INEL) are discussed.

19882 (LA-UR—80-399) **Applications of digital image restoration to photographic evidence.** Trussell, H.J.; Cannon, T.M. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-800512—1). Dep. NTIS, PC A02/MF A01.

From Carnahan conference on crime countermeasures; Lexington, KY, USA (14 May 1980).

A review of the cepstral method of blur determination for motion blur and out-of-focus lens blur is given. A review of the maximum a posteriori restoration (MAP) method is given. The reasons why this method produces few artifacts are discussed. Results of the complete image restoration process are given. 8 figures.

19883 (ORNL/CSD/TM—103) **SLIDES II: a program to draw text, slides and posters.** McCollough, D.H.; Fischer, K.N. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 93p. Dep. NTIS, PC A05/MF A01.

SLIDES is a program which takes text and commands as input and prepares lettered slides and posters. Originally written by Richard Bertrand and John Schofield at Argonne National Laboratory, SLIDES has been modified to operate in an interactive design mode on the PD-10 as well as in a batch production mode on the IBM computers. When run on the time-sharing computer, the program can display its output on a graphics terminal; in batch, it can direct its output to a variety of plotters. The program uses DISSPLA graphical subroutines. This report, revised from ANL-77-26 and again revised from ORNL/CSD/TM-44, contains material written for the beginning user, who should be able to produce useful slides or posters by following the examples. This report also serves as a complete reference for the SLIDES program. 4 figures.

19884 (SLAC-TN—80-1) **COM: a Unibus troubleshooting tool.** Oxoby, G.J.; Trang, Q.H. (Stanford Linear Accelerator Center, CA (USA)). Mar 1980. Contract EY-76-C-03-0515. 7p. Dep. NTIS, PC A02/MF A01.

In a computer-controlled system it is often difficult to troubleshoot the hardware and software. The task is even more complicated in the case of transient faults on a large system with many I/O ports. A module to help diagnose problems on a Digital Equipment Corp. PDP11 system was designed and built by Group B at SLAC. It monitors the Unibus control lines, keeps a history of the last sixteen Unibus operations, and can be programed to interrupt the PDP11 when a particular word appears either on the address or data lines. 2 figures.

19885 (UCID—30177) **Macros for making viewgraphs and color slides.** Storch, N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jan 1980. Contract W-7405-ENG-48. 25p. Dep. NTIS, PC A02/MF A01.

This report describes a set of macros that make it easier to use TRIX AC, the TRIX RED report editor, and REDPP to generate viewgraphs or slides for technical presentations. Slides can be generated directly by the FR80 camera. Viewgraphs are made by feeding computer-generated RJET or FR80 hardcopy into standard viewgraph-making machines. Each individual slide or viewgraph can consist of up to twenty-five 45-character lines. A bold, roman sans-serif font is specified. 6 figures.

19886 **Modern statistical techniques in data analysis.** Tukey, J.W. (Bell Labs., Murry Hill, NJ). pp 9-18 of Proceedings of the fifth biennial international CODATA conference. Dreyfus, B. (ed.). Elmsford, NY; Pergamon Press Inc. (1977).

From 5. CODATA conference; Boulder, CO, USA (28 Jun 1976).

In recent years quite a lot has been learned about how to formulate, how to study, and how to do better in solving both simple and more complex problems treated by weighted least-squares analysis. These newly developed methods are explained. Some of the topics treated are the following: the normal distribution, arithmetic means, resistance, efficiency, triefficiency, deviation-dependent weighting, iterative and effective weights, standard error for psi/w centers, degrees of freedom, the arithmetic mean as a limiting case, comparing two batches, and analogs of linear least-squares techniques. (RWR)

INFORMATION HANDLING

REFER ALSO TO CITATION(S) 18909, 19128, 19585, 19762

19887 (DOE/TIC—85(Rev.13)) **Energy information data base: report number codes.** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Sep 1979. 298p. Dep. NTIS, PC A13/MF A01.

Each report processed by the US DOE Technical Information Center is identified by a unique report number consisting of a code plus a sequential number. In most cases, the code identifies the originating installation. In some cases, it identifies a specific program or a type of publication. Listed in this publication are all codes that have been used by DOE in cataloging reports. This compilation consists of two parts. Part I is an alphabetical listing of report codes identified with the issuing installations that have used the codes. Part II is an alphabetical listing of installations identified with codes each has used. (RWR)

19888 (DOE/TIC—4584-R4) **Energy information data base: energy categories.** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Mar 1980. 70p. Dep. NTIS, PC A04/MF A01.

Citations entered into DOE's computerized bibliographic information system are assigned six-digit subject category numbers to group information broadly for storage, retrieval, and manipulation. These numbers are used in the preparation of printed documents, such as bibliographies and abstract journals, to arrange the citations and as searching aids in the on-line system, DOE/RECON. This document has been prepared for use by those individuals responsible for the assignment of category numbers to documents being entered into the Technical Information Center (TIC) system, those individuals and organizations processing magnetic tape copies of the files, those individuals doing on-line searching for information in TIC-created files, and others who, having no access to RECON, need printed copy. The six-digit numbers assigned to documents are listed, along with the category names and text to define the scope of interest. Asterisks highlight those categories added or changed since the previous printing, and a subject index further details the subject content of each category. (RWR)

19889 (ORNL—5492) **Personnel involved in nuclear standards development: 1980 directory.** Carr, S.J. (ed.). (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 310p. Dep. NTIS, PC A14/MF A01.

The development of nuclear standards is an active and necessary endeavor that is concerned with the safe, orderly, and economic development of nuclear potential. There are almost 4100 people from the teachnical community who are presently involved either in writing nuclear standards, including codes, or in the management and processing roles necessary for their approval and promulgation. This document identifies the current participation of each individual as member, chairman, cochairman (vice-chairman), or secretary of about 700 standards development committees and groups. The standards committees and groups are identified with the organizations that are responsible for the preparation, review, and maintenance of the standards and that provide support through supervisory committees and headquarters staff. This directory includes four major sections: personnel, employers, committees, and a Key-Word-in-Context (KWIC) Index of committee titles. It can also be used to identify the participation of employers as well as to recognize the contributions of individuals to the often interdisciplinary activity of standards development.

19690 **Proceedings of the fifth biennial international CODATA conference.** Dreyfus, B. (ed.). Contract EY-76-C-02-2849. Elmsford, NY; Pergamon Press Inc. (1977). 666p. (CONF-760643—).

From 5. CODATA conference; Boulder, CO, USA (28 Jun 1976).

Individual abstracts were prepared for 55 of the 111 papers in this volume. Seven other papers have already been cited in ERA, and those can be found by reference to the entry CONF-760643— in the Report Number Index. The remaining papers were determined to be outside the scope of coverage of the data base. (RWR)

19891 **Energy Research and Development Administration program and data needs.** Richman, D.M.; Gottschalk, C.M. (Energy Research and Development Administration, Washington, DC). pp 227-235 of Proceedings of the fifth biennial international CODATA conference. Dreyfus, B. (ed.). Elmsford, NY; Pergamon Press Inc. (1977).

From 5. CODATA conference; Boulder, CO, USA (28 Jun 1976).

The purpose, plan, and organization of ERDA are sketched, and ERDA's international activities are summarized. The emphasis of the paper is on the RD and D activities of ERDA and the organized data collection needs for these energy RD and D programs. The discussion summarizes these programs and goals; and identifies, with the aid of examples, organized data needs, mainly numerical, and how they are being met. Energy technology programs and data needs are examined for the following areas: fossil energy, solar energy, geothermal energy, conservation, fusion power, nuclear fuel cycle and safeguards R and D, fission reactor development, environment and safety, and basic energy sciences. The need for organized data collection is pointed out, and the ERDA Technical Information Services Program is described; this program is the vehicle designated to acquire, compile, organize, evaluate, and disseminate data in support of agency-wide RD and D programs. 2 figures. (RWR)

CIVILIAN DEFENSE

19892 (PB—296946) **The effects of nuclear war.** (Office of Technology Assessment (U.S. Congress), Washington, DC). May 1979. 159p. NTIS, PC A08/MF A01.

The study examines the full range of effects that nuclear war would have on civilians: direct effects from blast and radiation; and indirect effects from economic, social, and political disruption. Particular attention is devoted to the ways in which the impact of a nuclear war would extend over time. Two of the study's principal findings are that conditions would continue to get worse for some time after a nuclear war ended, and that the effects of nuclear war that cannot be calculated in advance are at least as important as those which analysts attempt to quantify. The report provides essential background for a range of issues relating to strategic weapons and foreign policy. It translates what is generally known about the effects of nuclear weapons into the best available estimates about the impact on society if such weapons were used. It calls attention to the very wide range of impacts that nuclear weapons would have on a complex industrial society, and to the extent of uncertainty regarding these impacts.

CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

DOE Energy Information Data Base: Corporate Author Entries (TID-4585) is used in the standardization of corporate entries. TID-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

A

Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.
Potential use of California lignite and other alternate fuel for enhanced oil recovery. Phase I and II. Final report, 5:18384 (SAN—2157-1)
Refinery heater screening study. Report for 1978, 5:19312 (PB—80-102015)

Ad Hoc Population Dose Assessment Group, Washington, DC (USA)
Population dose and health impact of the accident at the Three Mile Island Nuclear Station. Final report, 28 March-7 April 1978, 5:18897 (PB—296197)

Aerojet Energy Conversion Co., Sacramento, CA (USA)
Multi-Megawatt Organic Rankine Engine power plant (MORE). Phase IA final report: system design of MORE power plant for industrial energy conservation emphasizing the cement industry, 5:19244 (DOE/ET/12434—T1)

Aerospace Corp., El Segundo, CA (USA)
Assessment of feasibility, economics, and market potential for a molten salt system at 1000°F reheat steam: feasibility, economics, and market potential, 5:18629 (DOE/ET/21060—2)

Aerospace Corp., El Segundo, CA (USA). Energy and Resources Div.
Analysis of photovoltaic total energy systems for single family residential applications, 5:18625 (ATR—78(7694)-02)-1)
Assessment of solar-geothermal hybrid system concepts, 5:18796 (SAN—1101-14/1)
Electric utility application of wind energy conversion systems on the island of Oahu, 5:18805 (ATR—78(7598)-1)
Electric utility application of wind energy conversion systems on the island of Oahu, 5:18808 (ATR—78(7598)-2)

AIA Research Corp., Washington, DC (USA)
Survey of passive solar buildings, 5:18706 (HUD-PDR—287(2))

Alaska Univ., Fairbanks (USA). Inst. of Marine Science
Transport and reaction of heavy metals in Alaskan fjord-estuaries. Annual report, July 1, 1978-June 30, 1979, 5:19561 (DOE/EV/70001—T1)

Alfa Romeo, Inc., Englewood Cliffs, NJ (USA)
Application for certification for 1979 model year for light-duty vehicles - Alfa Romeo, Inc, 5:19110 (PB—294377)

Altas Corp., Santa Cruz, CA (USA)
Control of solar energy systems for heating and cooling, 5:18671 (COO—4578-1)
Investigation of methods to transfer heat from solar liquid-heating collectors to heat storage tanks. Final report, 5:18781 (SAN—1238-1)
Monitoring the performance of solar heated and cooled buildings. Volume 1. Data acquisition equipment for the spectrum of electric utility projects. Final report, 5:18705 (EPRI-ER—1239(Vol.1))

American Association of State Highway and Transportation Officials, Washington, DC
Evaluating options in statewide transportation planning/programming - techniques and applications. Final report, 5:19018 (PB—296495)

American Honda Motor Co., Inc., Gardena, CA
Application for certification for 1979 model year for light-duty vehicles - Honda, 5:19118 (PB—294385)

American Motors Corp., Detroit, MI
Application for certification for 1979 model year for light-duty vehicles - American Motors Corporation, 5:19115 (PB—294382)

Ames Lab., IA (USA)
Deuterium superlattice formation in lanthanum trideuterides: the NMR evidence, 5:19151 (IS-M—272)
Development of multielement sampling and analyses methods using inductively coupled plasma-atomic emission spectroscopy, 5:19175 (IS—4728)
Field induced magnetic form factor of Zr, 5:19804 (IS-M—221)
Multilaboratory analytical quality control for the hydrogeochemical and stream sediment reconnaissance. Quality control report for July 1979, 5:19174 (IS—4712)
Multilaboratory analytical quality control for the hydrogeochemical and stream sediment reconnaissance, 5:19168 (IS—4726)
Spin waves in static non-periodic structures, 5:19808 (IS-M—220)

Amoco Research Center, Naperville, IL (USA)
Coal liquefaction catalyst development. Quarterly progress report No. 1, 5:18325 (DOE/ET/14803—T1)

AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki
Shaping of H^- ion beams for accelerators in surface-plasma sources, 5:19735 (UCRL-Trans—11549)

Applied Decision Analysis, Inc., Menlo Park, CA (USA)
Aggregated systems model: a tool for nuclear safeguards decision-making, 5:18488 (UCRL—82212)

ARCO Solar, Inc., Chatsworth, CA (USA)
Automated solar panel assembly line. LSA task: production processes and equipment. Quarterly report No. 4, 5:18581 (DOE/JPL/955278—79/4)

Argonne National Lab., IL (USA)
Assessment of the status of fluidized-bed combustion based on the papers of the Fifth International Conference: methodology and results, 5:18372 (ANL/ECT—6)
Design and installation manual for thermal energy storage, 5:18778 (ANL—79-15(Ed.2))
Environmental control technology survey of selected US strip mining sites. Volume 2A: Ohio: water quality impacts and overburden chemistry of Ohio study site, 5:19549 (ANL/EMR—2(Vol.2A))
Finite-element method for above-core structures, 5:18888 (ANL—79-104)
Level-one modules library for DSNP: Dynamic Simulator for Nuclear Power-plants, 5:18846 (ANL-CT—77-22(Rev.02))

Nondestructive evaluation techniques for high-temperature ceramic components. Eighth quarterly report, July-September 1979, 5:19215 (ANL/MSD—79-7)
Optimization of radially heterogeneous 1000-MW(e) LMFBR core configurations. Design and performance of reference cores. Research project 620-25, 5:18856 (EPRI-NP—1000(Vol.1))
Optimization of radially heterogeneous 1000-MW(e) LMFBR core configurations. Appendixes A and B. Research project 620-25, 5:18857 (EPRI-NP—1000(Vol.2))
Optimization of radially heterogeneous 1000-MW(e) LMFBR core configurations. Appendixes D and E. Research project 620-25, 5:18859 (EPRI-NP—1000(Vol.4))
Optimization of radially heterogenous 1000-MW(e) LMFBR core configurations. Appendix C. Research project 620-25, 5:18858 (EPRI-NP—1000(Vol.3))
OTEC power system development and environmental impacts, 5:18639 (CONF-800210—3)
Pressure studies of the Fermi surfaces of α-U and UGe_3, 5:19135 (SAND—80-0041C)
Proceedings of the National Ecological Assessment Workshop, 5:19573 (ANL/AA—15)
Recent contributions to fusion reactor design and technology development, 5:19838 (ANL/FPP/TM—127)
Reliability, maintainability, and availability engineering for integrated community energy systems, 5:19035 (ANL/CNSV—6)
Reverse absorption mode of the HYCSOS chemical heat pump with low grade (~ 30°C) thermal energy inputs, 5:18670 (CONF-800133—1)
Screening of granular sorbents for the removal of gaseous alkali metal compounds from hot flue gas, 5:18832 (ANL/CEN/FE—79-17)

Arizona Public Service Co., Phoenix (USA)
Airport Solar Photovoltaic Concentrator Project. Phase 1 - final report, June 1, 1978-February 28, 1979, 5:18606 (DOE/CS/05317—1)

Army Military Personnel Center, Alexandria, VA (USA)
Siberian development and its implications for the USSR. Final report, 5:18959 (AD-A—068571)
The $^{11}B(p,n)^{11}C$ reaction: measurements of differential cross sections at proton energies between 3.1 and 4.5 MeV, and applications to depth profiling. Final report, 5:19768 (AD-A—074310/4)

Army Tropic Test Center, New York 09827 (USA)
Methodology investigation exposure/performance tests of selected materiel items. Final report, July 1973-April 1975, 5:18908 (AD-A—074001/9)

Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations
Status report on studies to assess the feasibility of storing nuclear waste in Columbia plateau basalts, 5:18464 (RHO-BWI-SA—19)

Auburn Univ., AL (USA). Coal Conversion Lab.
Studies in coal liquefaction with application to the SRC and related processes. Quarterly report, January-March 1978, 5:18333 (FE—2454-7)
Studies in coal liquefaction with application to the SRC and related processes. Final summary report, July 1976-July 1878, 5:18336 (FE—2454-8)

Australian Atomic Energy Commission Research Establishment, Lucas Heights
Net fossil energy savings for alternative mixes in various electric supply systems, 5:18934 (AAEC/E—451)

Aydin Energy Div., Palo Alto, CA (USA)
Test and evaluation of the BBC CQK 200-4 modulator tube for the MFTF sustaining neutral beam power supply system, 5:19858 (UCRL—82951)

B

Battelle Columbus Labs., OH (USA)
Criteria for assessment of environmental pollutants from coal cleaning processes. Final report, September 1976-April 1979, 5:18352 (PB—80-102791)
Development of a low-temperature, low-cost, black liquid solar collector. Phase II. Semi-annual report, September 1, 1979-February 29, 1980, 5:18752 (ALO—30171-1)
Development of an accelerated test design for predicting the service life of the solar array at Mead, Nebraska, 5:18610 (DOE/JPL/954328—13)

Battelle Pacific Northwest Labs., Richland, WA (USA)
Analysis of steady state combined forced and free convection data in rod bundles, 5:18865 (PNL-SA—7878)
Assessment of effectiveness of geologic isolation systems. Geologic factors in the isolation of nuclear waste: evaluation of long-term geomorphic processes and catastrophic events, 5:18451 (PNL—2854)
Atmospheric trace element pollutants from coal combustion, 5:18353 (PNL-SA—7547)
Comparison of bitumen and cement immobilization of intermediate- and low-level radioactive waste, 5:18445 (PNL-SA—7499)
Durability of metals from archaeological objects, metal meteorites, and native metals, 5:19723 (PNL—3198)
Economics of large-scale thorium oxide production: assessment of domestic resources, 5:18415 (PNL—3150)
Fusion reactor design studies: standard unit costs and cost scaling rules, 5:19843 (PNL—2987)
Improvement of sputtered oxide coating adherence and integrity for turbine airfoil applications. Combustion zone durability program. Task III: dense surface sputtered ceramic coatings. Annual technical progress report, October 1, 1978-September 30, 1979, 5:18826 (PNL—3289)
Influence of irrigation and weathering reactions on the composition of percolates from retorted oil shale in field lysimeters, 5:18414 (PNL-SA—7473)
Mercury in mussels of Bellingham Bay, Washington, (USA), 5:19711 (PNL-SA—8055)
Needed research on the terrestrial effects of coal gasification and liquefaction technologies, 5:18354 (PNL-SA—7553)
Pacific Northwest Laboratory annual report for 1979. Part 3. Atmospheric sciences, 5:19294 (PNL—3300(Pt.3))
Physical modeling of flow over an axisymmetric knoll under neutral atmospheric conditions, 5:19352 (PNL—3205)
Potential radiological impact of a conceptual Hanford Nuclear Energy Center, 5:19503 (PNL-SA—7497)
Potential use of dry cooling in support of advanced energy generation systems, 5:18823 (PNL—3149)
Proceedings of the Task 4 Waste Isolation Safety Assessment Program second contractor information meeting, 5:18452 (PNL-SA—7352(Vol.1))
Proceedings of the Task 4 Waste Isolation Safety Assessment Program second contractor information meeting, 5:18456 (PNL-SA—7352(Vol.2))
Summary of current practices at several DOE facilities for maintaining exposures to as low as practicable, 5:18480 (PNL-SA—6795)
Wind characteristics for design of wind turbines: research in the USA, 5:18806 (PNL-SA—7967)

Bechtel National, Inc., San Francisco, CA (USA)
Assessment of three technologies for the treatment of cooling tower blowdown. Final report, September 1978-July 1979, 5:18822 (PB—80-102767)

Beet Sugar Development Foundation, Fort Collins, CO (USA)
Evaporation by mechanical vapor recompression. Technical progress report, September 1-December 31, 1979, 5:19025 (DOE/CS/40208—T1)

Bell Labs., Murray Hill, NJ (USA)
Approaches to analysis of data that concentrate near higher-dimensional manifolds, 5:19266 (COO—2310-7)

Bendix Corp., Kansas City, MO (USA)
Control of electrostatic damage to electronic circuits, 5:19217 (BDX—613-2428)

Bendix Field Engineering Corp., Grand Junction, CO (USA)
Engineering report on the Brushy Basin drilling project, Cedar Mountain, Emery County, Utah, 5:18417 (GJBX—48(80))

Bettis Atomic Power Lab., West Mifflin, PA (USA)
Characteristics of the Zircaloy-4 tubing in LWBR fuel rods. (LWBR Development Program), 5:18867 (WAPD-TM—869)

Bio-Gas of Colorado, Inc., Arvada (USA)
Conversion of feedlot wastes into pipeline gas, 5:18521 (PB—296363)
Energy potential through bio-conversion of agricultural wastes, 5:18522 (PB—296444)

Bio-Gas of Colorado, Inc., Loveland (USA)
Methane on the move. a discussion of small anaerobic digesters. Final report, 5:18523 (PB—296542)

Boeing Co., Seattle, WA (USA)
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SUBJECT INDEX

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SUBJECT DESCRIPTOR/QUALIFIER
Title, (supplementary information), citation number, (report number)

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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EY-76-C-02-0069	Chicago Univ., IL (USA). Dept. of Radiology	
	5:19260	CONF-790782—1
EY-76-C-02-0535	Colorado Univ., Boulder (USA). Dept. of Physics and Astrophysics	
	5:19758	COO—535-767
EY-76-C-02-1198	United Technologies Research Center, East Hartford, CT (USA)	
	5:19264	COO—1198-1284
EY-76-C-02-1545	Ohio State Univ., Columbus (USA). Dept. of Physics	
	5:19750	DOE/ER/01545—271
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EY-76-C-02-2541	Massachusetts General Hospital, Boston (USA)	
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EY-76-C-02-2799	Syska and Hennessy, New York (USA)	
	5:19003	COO—2799-T6
EY-76-C-02-2839	Dynatherm Corp., Cockeysville, MD (USA)	
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EY-76-C-02-2939	Toronto Univ., Ontario (Canada). Dept. of Mechanical Engineering	
	5:18539	DOE/CS/32939—9
	5:18780	DOE/CS/32939—10
EY-76-C-02-2950	General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.	
	5:18827	COO—2950-1
EY-76-C-02-2975	General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.	
	5:19137	COO—2975-37
EY-76-C-02-3073	Princeton Univ., NJ (USA). Plasma Physics Lab.	
	5:18970	PPPL—1649
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EY-76-C-03-1101-008	**Aerospace Corp., El Segundo, CA (USA). Energy and Resources Div.**	
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EY-76-C-03-1101-014	**Aerospace Corp., El Segundo, CA (USA). Energy and Resources Div.**	
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EY-76-C-03-1137	**San Diego Gas and Electric Co., CA (USA)**	
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EY-76-C-03-1238	**Altas Corp., Santa Cruz, CA (USA)**	
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EY-76-C-03-1288	**Varian Associates, Inc., Palo Alto, CA (USA)**	
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EY-76-C-04-0053	**Mound Facility, Miamisburg, OH (USA)**	
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EY-76-C-04-0613	**Bendix Corp., Kansas City, MO (USA)**	
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EY-76-C-04-0656	**General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.**	
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EY-76-C-04-0789	**Terra Tek, Inc., Salt Lake City, UT (USA)**	
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EY-76-C-05-2972	**Texas Univ., Austin (USA). Dept. of Physics**	
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EY-76-C-05-5194	**West Virginia Univ., Morgantown (USA). Dept. of Geology and Geography**	
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EY-76-C-05-5203	**Illinois State Geological Survey, Urbana (USA)**	
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EY-76-C-06-1388	**Washington Univ., Seattle (USA). Dept. of Physics**	
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EY-76-C-06-1830	**Battelle Pacific Northwest Labs., Richland, WA (USA)**	
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EY-76-C-11-0014	**Bettis Atomic Power Lab., West Mifflin, PA (USA)**	
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EY-76-S-02-2310	**Stanford Linear Accelerator Center, CA (USA)**	
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EY-76-S-02-2577	**Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.**	
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EY-76-S-02-2725	**Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Biochemistry**	
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EY-76-S-02-2853	**Massachusetts Univ., Amherst (USA)**	
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EY-76-S-02-2945	**Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science**	
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EY-76-S-02-4051	Brown Univ., Providence, RI (USA). Div. of Engineering	
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EY-76-S-02-4131	Massachusetts Inst. of Tech., Cambridge (USA). Aeroelastic and Structures Research Lab.	
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EY-76-S-06-2227-029	Oregon State Univ., Corvallis (USA). School of Oceanography	
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EY-76-S-06-2229-001	Alaska Univ., Fairbanks (USA). Inst. of Marine Science	
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EY-76-S-06-2230-004	Oregon Univ., Eugene (USA). Inst. of Theoretical Science	
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FG02-79R510121	Michigan Technological Univ., Houghton (USA). Dept. of Chemistry and Chemical Engineering	
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FG02-79R510129	Minnesota Univ., Minneapolis (USA). Dept. of Mechanical Engineering	
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NAS-7-100-954851	California Univ., Los Angeles (USA). Dept. of Materials	
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NAS-7-100-955244	Optical Coating Lab., Inc., City of Industry, CA (USA). Photoelectronics Div.	
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1	5:18563	*See* CRN-CPR-78-12
CONF-780657-	(23. meeting of the Health Physics Society, Minneapolis, MN, USA, 18-23 Jun 1978)	
8	5:18480	*See* PNL-SA-6795
CONF-780857-	(Conference on dynamical properties of heavy-ion reactions, Johannesburg, South Africa, 1-3 Aug 1978)	
4	5:19798	Dep. NTIS, PC A03/MF A01
CONF-7808121-	(Workshop on environmental research needs for coal liquefaction/fasification technologies, Leesburg, VA, USA, Aug 1978)	
1	5:18354	*See* PNL-SA-7553
CONF-7810227-	(2. contractor information meeting, Seattle, WA, USA, 1-5 Oct 1978)	
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42	5:18879	*See* HEDL-SA-1605-FP
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12	5:18445	*See* PNL-SA-7499
CONF-790219-	(AIME annual meeting, New Orleans, LA, USA, 18-21 Feb 1979)	
15	5:18353	*See* PNL-SA-7547
CONF-790348-	(Conference on the p,n reaction and the nucleon-nucleon force, Telluride, CO, USA, 29-31 Mar 1979)	
7	5:19779	Dep. NTIS, PC A03/MF A01
CONF-790440-	(12. oil shale symposium, Golden, CO, USA, 18-20 Apr 1979)	
6	5:18414	*See* PNL-SA-7473
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CONF-7905140-	(15. symposium on electron, ion and photon beam technology, Boston, MA, USA, May 1979)	
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CONF-7905142-	(2. international symposium on hadron structure and multiparticle production, Kazimierz, Poland, 20-26 May 1979)	
1	5:19751	*See* DOE/ER/70004-232
CONF-790654-	(IAEA international symposium on occupational radiation exposure in nuclear fuel cycle facilities, Los Angeles, CA, USA, 18-22 Jun 1979)	
2	5:19703	*See* DPSPU-79-30-3
CONF-790666-	(34. Northwest regional meeting of the American Chemical Society, Richland, WA, USA, 13-15 Jun 1979)	
7	5:19170	*See* RHO-SA-115
CONF-7906153-	(Advanced technology meeting on advanced solar thermal power systems, Long Beach, CA, USA, 19-21 Jun 1979)	
1	5:18775	*See* GA-A-15759
CONF-790711-	(International symposium on underground disposal of radioactive wastes, Otaniemi, Finland, 2-6 Jul 1979)	
5	5:18464	*See* RHO-BWI-SA-19
CONF-790728-	(24. annual meeting of the Health Physics Society, Philadelphia, PA, USA, 7-13 Jul 1979)	
6	5:19503	*See* PNL-SA-7497
CONF-790735-	(Stochastic molecular dynamics conference, Woods Hole, MA, USA, 8-11 Jul 1979)	
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4	5:19865	*See* UCRL-82550(Rev.1)
CONF-790782-	(21. annual meeting of the American Association of Physicists in Medicine, Atlanta, GA, USA, 29 Jul-2 Aug 1979)	
1	5:19260	Dep. NTIS, PC A02/MF A01
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23	5:18539	*See* DOE/CS/32939-9
CONF-790816-	(International meeting on fast reactor safety technology, Seattle, WA, USA, 19-23 Aug 1979)	
86	5:18893	*See* HEDL-SA-1747-FD
CONF-790847-	(International conference on high energy physics and nuclear structure, Vancouver, Canada, 13-17 Aug 1979)	
16	5:19773	*See* DOE/ER/01388-807
CONF-7908102-	(International conference on two-photon interactions, Lake Tahoe, CA, USA, 30 Aug-1 Sep 1979)	
2	5:19745	*See* SLAC-PUB-2461
CONF-7908111-	(19. international commission on illumination session, Kyoto, Japan, 21-28 Aug 1979)	
1	5:19004	*See* LBL-9960
CONF-790909-	(International conference on magnetism, Munich, F.R. Germany, Sep 1979)	
16	5:19808	*See* IS-M-220
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CONF-790951-	(NATO advanced research institute on in vitro toxicity for environmental agents, Monte Carlo, Monaco, 22-29 Sep 1979)	

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2	5:19709	*See* BNL-27251
CONF-7909128-	(IEA expert meeting, Stockholm, Sweden, 12-13 Sep 1979)	
1	5:18806	*See* PNL-SA-7967
CONF-791037-	(IEEE nuclear science symposium, San Francisco, CA, USA, 17-19 Oct 1979)	
25	5:19259	*See* BNL-26869
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CONF-791048-	(The Combustion Institute Western States Section meeting, Berkeley, CA, USA, 15-16 Oct 1979)	
6	5:19740	*See* SAND-79-8775
CONF-7910108-	(Symposium on separation science and technology for energy applications, Gatlinburg, TN, USA, 30 Oct-2 Nov 1979)	
2	5:19177	*See* DP-MS-79-48
CONF-7910123-	(Lunar and Planetary Institute topical conference on the ancient sun, Boulder, CO, USA, Oct 1979)	
3	5:19173	*See* LBL-10487
CONF-7910136-	(2. international symposium on data analysis and informatics, IRIA, Versailles, France, 17-19 Oct 1979)	
1	5:19266	*See* COO-2310-7
CONF-791102-	(8. symposium on engineering problems of fusion research, San Francisco, CA, USA, 13-16 Nov 1979)	
124	5:19857	*See* UCRL-82873
145	5:19858	*See* UCRL-82951
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74	5:18483	*See* DP-MS-79-54
75	5:18865	*See* PNL-SA-7878
CONF-791108-	(72. AICHE meeting, San Francisco, CA, USA, 25-29 Nov 1979)	
20	5:18780	*See* DOE/CS/32939-10
CONF-791109-	(5. workshop on laser interaction, Rochester, NY, USA, 5-9 Nov 1979)	
2	5:19866	*See* UCRL-83541
CONF-791117-	(ANS topical conference, Kiawah Island, SC, USA, 26 Nov 1979,-19 Nov 1979,/ REPLACES CONF-791180)	
21	5:18482	*See* DP-MS-79-43
CONF-791127-	(DOE chemical energy storage and hydrogen energy systems contracts review meeting, Reston, VA, USA, 12-14 Nov 1979)	
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CONF-791179-	(Symposium on pollution and physiology of marine organisms, Milford, CT, USA, 6-9 Nov 1979)	
1	5:19711	*See* PNL-SA-8055
CONF-791180-	(American Nuclear Society conference, Charleston, SC, USA, 25 Nov 1979/ REPLACED BY CONF-791117)	
1	5:18872	*See* HEDL-SA-1745-FP
CONF-791204-	(2. Miami international conference on alternative energy sources, Miami Beach, FL, USA, 10-13 Dec 1979)	
27	5:18508	*See* BNL-27347
CONF-791221-	(Semiannual conference for advanced solar thermal technology, Phoenix, AZ, USA, 11-13 Dec 1979)	
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CONF-800110-	(International conference on developments in atomic plasma spectrochemical analyses, San Juan, Puerto Rico, 7-11 Jan 1980)	
2	5:18427	*See* K/UR-36
CONF-800120-	(Conference on theoretical particle physics, Guangchou, China, 5-14 Jan 1980)	
2	5:19748	*See* SLAC-PUB-2450
CONF-800123-	(Orbis Scientiae, Coral Gables, FL, USA, 14-17 Jan 1980)	
3	5:19756	*See* LA-UR-80-913
CONF-800131-	(Nuclear structure with intermediate energy probes workshop, Los Alamos, NM, USA, 14-17 Jan 1980)	
4	5:19743	*See* COO-2853-12
CONF-800133-	(Workshop on thermochemical energy storage, Stockholm, Sweden, 7-9 Jan 1980)	
1	5:18670	Dep. NTIS, PC A02/MF A01
CONF-800205-	(American Institute of Metallurgical Engineers meeting, Las Vegas, NV, USA, Feb 1980)	
6	5:19147	*See* HEDL-SA-1937
CONF-800210-	(IEEE Region 6 conference, San Diego, CA, USA, 20-22 Feb 1980)	
3	5:18639	Dep. NTIS, PC A02/MF A01
CONF-800226-	(Specialists meeting on decay heat removal and natural circulation in FBR's, Upton, NY, USA, 28-29 Feb 1980)	
2	5:18894	*See* HEDL-SA-1920S
5	5:18880	*See* HEDL-SA-1921-FP
CONF-800231-	(3. international conference on nondestructive evaluation in the nuclear industry, Salt Lake City, UT, USA, 11-13 Feb 1980)	
1	5:18861	*See* HEDL-SA-2014
CONF-800301-	(2. international symposium on gaseous dielectrics, Knoxville, TN, USA, 9-13 Mar 1980)	
1	5:18839	Dep. NTIS, PC A02/MF A01
CONF-800303-	(179. national meeting of the American Chemical Society, Houston, TX, USA, 23-28 Mar 1980)	
11	5:18441	*See* DP-MS-79-94
12	5:18443	*See* LA-UR-80-835
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CONF-800315-	(2. symposium of the European Safeguards Research and Development Association, Edinburgh, UK, 26 Mar 1980)	
5	5:18488	*See* UCRL-82212
6	5:19261	*See* LA-UR-80-878
7	5:18485	*See* LA-UR-80-801
8	5:18486	*See* LA-UR-80-802
9	5:19172	*See* LA-UR-80-847
CONF-800318-	(Pittsburgh conference, Atlantic City, NJ, USA, 9-14 Mar 1980)	
2	5:18862	*See* HEDL-SA-2027-A-FP
CONF-800320-	(3. topical conference on high temperature plasma diagnostics, Los Angeles, CA, USA, 17-19 Mar 1980)	
2	5:19819	Dep. NTIS, PC A02/MF A01
CONF-800322-	(Defense Nuclear Agency meeting, Washington, DC, USA, 25 Mar 1980/ REPLACED BY CONF-800307)	
1	5:19280	*See* LA-UR-80-620
CONF-800325-	(ASME symposium on fusion energy products, Albuquerque, NM, USA, 20-21 Mar 1980)	
3	5:19861	*See* DOE/ID/01570-T3
4	5:19845	*See* UCRL-83962
CONF-800327-	(2. joint conference on applications of air pollution meteorology, New Orleans, LA, USA, 24-27 Mar 1980)	
1	5:19204	*See* SAND-79-1937C
10	5:19346	*See* UCRL-84135
CONF-800328-	(6. ISCRE, Nice, France, 25-27 Mar 1980)	
1	5:19184	Dep. NTIS, PC A02/MF A01

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1	5:18889	Dep. NTIS, PC A03/MF A01
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1	5:18874	*See* GA-A-15677
CONF-800334-		(2. DOE environmental control symposium, Reston, VA, USA, 17-19 Mar 1980)
1	5:18560	*See* BNL-27334
2	5:18356	*See* UCRL-84075
3	5:18446	Dep. NTIS, PC A02/MF A01
CONF-800335-		(7. national solid state power conversion conference and exhibit, San Diego, CA, USA, 25-27 Mar 1980)
1	5:19250	*See* BNL-27216
CONF-800336-		(Radiopharmaceuticals: structure activity relationships symposium, Hartford, CT, USA, 21-23 Mar 1980)
1	5:19197	Dep. NTIS, PC A05/MF A01
CONF-800337-		(Winter workshop on nuclear dynamics, Lake Tahoe, NV, USA, 17 Mar 1980,-21 Mar 1980/REPLACED BY CONF-800329)
1	5:19799	Dep. NTIS, PC A02/MF A01
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CONF-800338-		(High energy laser propagation adaptive optics meeting, Redstone Arsenal, AL, USA, 19-20 Mar 1980)
1	5:19803	*See* UCRL-84021
CONF-800342-		(76. annual meeting Cordilleran Section Geological Society of America, Corvallis, OR, USA, 19-21 Mar 1980)
3	5:18465	*See* RHO-BWI-SA-30
CONF-800402-		(International symposium on the properties and applications of metal hydrides, Colorado Springs, CO, USA, 7-11 Apr 1980)
9	5:19151	*See* IS-M-272
CONF-800403-		(ANS thermal reactor safety meeting, Knoxville, TN, USA, 8-11 Apr 1980)
12	5:18875	*See* GEFR-SP-203
CONF-800417-		(European Physicists Society and Swiss National Science Foundation conference, Zurich, Switzerland, 9-11 Apr 1980)
1	5:19135	*See* SAND-80-0041C
CONF-800418-		(Joint conference of the 4th Kiev international conference on plasma theory and 4th congress on waves and instabilities in plasma, Nagoya, Japan, 15 Apr 1980)
1	5:19816	*See* SAND-80-0609C
2	5:19815	*See* SAND-80-0608C
CONF-800420-		(2. international ocean disposal symposium, Woods Hole, MA, USA, 15-18 Apr 1980)
1	5:18470	*See* SAND-79-2117C
CONF-800421-		(IEEE international symposium on circuits and systems, Houston, TX, USA, 28-30 Apr 1980)
1	5:19274	*See* UCRL-83931
CONF-800422-		(International conference on effect of deformation on rocks, Gottingen, F.R. Germany, 9-12 Apr 1980)
1	5:19728	*See* UCRL-83869
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1	5:18408	*See* UCRL-83741
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1	5:18980	*See* LA-UR-80-848
CONF-800437-		(Workshop on scale control and related topics, Los Alamos, NM, USA, 16-17 Apr 1980)
1	5:18799	*See* UCRL-84222
CONF-800440-		(6. annual reliability testing institute, Tucson, AZ, USA, 14-18 Apr 1980)
1	5:19217	*See* BDX-613-2428
CONF-800502-		(26. international instrumentation symposium, Seattle, WA, USA, 5-8 May 1980)
9	5:19275	*See* Y/DW-39
CONF-800505-		(34. annual technical conference of the American Society for Quality Control, Atlanta, GA, USA, 20-22 May 1980)
1	5:18933	Dep. NTIS, PC A02/MF A01
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1	5:19264	*See* COO-1198-1284
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1	5:19882	*See* LA-UR-80-399
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2	5:18472	*See* SAND-80-0323C
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1	5:19163	*See* SAND-79-1356C
CONF-800519-		(American Vacuum Society New Mexico Chapter meeting, Santa Fe, NM, USA, 6-8 May 1980)
1	5:19269	*See* GEPP-OP-491
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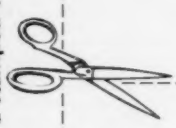

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